Application of Botany

2.1 Economic botany

(1) **Cereals :** These are the members of family Gramineae and grown for their edible seeds. They are characterised by the presence of caryopsis a type of fruit in which seed wall becomes fused with the ovary to form the husk. The true cereals are the following :

(i) **Wheat** (*Triticum aestivum*) **:** Wheat is the chief cereal used by man as food from ancient times. It is an annual grass and the inflorescence is a terminal spike consisting of 15–20 spikelets. In India, its cultivation is confined to north-west regions. The important varieties of wheat, grown in India are Sonalika, Sharbati, Sonara, Lerma Roja, Sonara 64 etc.; *Triticale hexaploides,* a man made variety is also cultivated; wheat is used mostly for human consumption; the flour is chiefly used for making bread, biscuits etc.; wheat straw is used in packing and as fodder.

(ii) **Maize** (*Zea mays*) **:** It is the second important cereal crop. Maize is a tall annual grass attaining a height of 4 to 10 feet; plants are monoecious. In India common varieties grown are Sona, Vijay, Jawahar, Amber etc. The maize grains are very nutritious; they contain high percentage of easily digestible carbohydrates, proteins and fats; the grains are also used in the manufacture of corn starch, glucose and alcohol; also used as a chief food for livestock; the fibre from stem and spathe is used in paper industry.

(iii) **Rice** (*Oryza sativa*) **:** Rice is the principal food crop of millions of people of the world. The rice plant is an annual grass attaining a height of 2–4 feet and produces a panicle, an inflorescence consisting of a number of fine branches; it grows best on damp soils where it can be flooded. The rice grains are used as a food after cooking; stem, husk etc., are used as fodder; grain is also used in the manufacture of alcoholic beverages.

(iv) **Sorghum** (*Sorghum vulgare*) **:** Sorghum is staple food for millions of peoples in Asia and Africa. It is a tall annual plant attaining a height of 6–12 feet; the stem is stout and the panicle much-branched. The grains are made into flour, often mixed with wheat, forming a nutritious food. The plants are used as fodder, in the manufacture of brushes, syrup and also in the paper industry.

(v) **Barley** (*Hordeum vulgare*) **:** Barley is an annual plant attaining a height of 3 feet. The inflorescence is a spike; the grains may be white, purple or red and are covered with husk.

Barley is used in the preparation of bread, cakes after mixing it with wheat flour; straw is used as a livestock feed; also used as a source of malt, to be used in the manufacture of beer, whisky, alcohol etc.

(vi) **Pearl millet or Bajra** (*Pennisetum typhoides*) **:** It is cultivated almost throughout India. The plants attain a height from 6–12 feet and the dark-brown spikes, 15–25 *cm* in length, occur in clusters. It is an important food for poor people in our country; the flour is used for making chapatis; the plants are also used as fodder.

(2) **Sugar :** Sugars are the end products of photosynthesis in green plants. Cane-sugar or sucrose is the main commercial sugar used world over for sweetening various food products. Some of the important sugar yielding plants are as follows :

(i) **Sugarcane** (*Saccharum officinarum*) **:** It belongs to family Gramineae and is the chief source of sugar in India. The plant reaches a height of 6 to 12 feet and a diameter 1 to 2 inches; the stem is solid with many fibrous strands and contains juice; the stems are cut close to the ground and are then sent to sugar mills for the extraction of sugar. Molasses is used in the manufacture of rum and industrial alcohol. Molasses is the mother liquor, left after extraction of sugar crystals.

(ii) **Sugar-beet** (*Beta vulgaris*) **:** It belongs to family Chenopodiaceae and is the source of sugar in cold countries. The sugar-beet is a biennial herb with white tap root. Sugar is extracted from the fleshy roots which contain 15–20% of sucrose. In India sugar-beet is not much used as a source of sugar but the roots and leaves are used as vegetables.

(3) **Fibres :** The fibre crops of the world rank second in importance to the food crops. Fibres are thread-like sclerenchymatous tissues obtained from different parts of the plant body. They are usually long with thick walls and pointed ends; the thickening of the walls is either due to the deposition of lignin or cellulose. Some of the important commercial fibres are as follows :

(i) **Cotton** (*Gossypium* sp. - **family Malvaceae**) **:** Cotton is the most important commercial textile fibres. It is used for a variety of purposes, especially in the manufacture of a large proportion of the clothing. Fibres are produced by the seed coats of various species of *Gossypium* and when separated from the seed are known as `lint'. Fibres are also used for making ropes, twines and threads; raw cotton is also used for stuffing pillows and cushions.

(ii) **Jute** (*Corchorus capsularis* and *C. olitorius* - **family Tiliaceae**) **:** It is a very valuable bast fibre and is second in use to cotton. The fibres are extracted by the process of retting in which the branches of plants are dipped in water for few days; after retting fibres are separated. Jute fibres are used for making gunny bags, packing cloth, carpets, cordage, curtains etc.

(iii) **Sunn hemp** (*Crotolaria juncea*-**family Papilionaceae**) **:** The plants are extensively cultivated in India. The long fibrous strands are made up of lignified phloem sclerenchyma cells which are obtained after retting. The fibres are used in the manufacture of ropes, canvas, nets, cordages etc.

(iv) **Flax** (*Linum usitatissimum* - **family Linaceae**) **:** The fibres are very strong, silky, short in length and are formed in the pericycle of the stem. They are made up of pure cellulose. Flax fibres are used in the manufacture of linen cloth, carpets, canvas, cigarette paper, insulating materials etc.

(v) **Hemp** (*Cannabis sativa* - **family Cannabinaceae**) **:** The fibres are obtained from the pericycle after retting. The hemp fibres are long, strong and durable but lack flexibility. It is used for the manufacture of ropes, cables, nets, canvas etc.

(vi) **Coir** (*Cocos nucifera* - **family Palmae**) **:** It is obtained from the fibrous mesocarp of the fruit; the fruits are dipped in marine water for many months and then beaten to separate the fibres. Coir is used for making brushes, doormats, carpets, sacs, bags, cordage etc.

(4) **Oils :** Oils are the complex chemical compounds which consists of hydrocarbons, esters, alcohols, aldehydes etc. The oils are of two kinds :

(i) Essential oils (ii) Fatty oils

There are several species of plants yielding both edible and industrial oils. Some of the important oils are :

(a) **Groundnut oil :** It is obtained from the seeds of *Arachis hypogea* -family Papilionaceae; refined oil is used in cooking and oil is converted into vegetable ghee by dehydrogenation.

(b) **Sesame or Til oil :** It is obtained from the seeds of *Sesamum indicum* - family Pedaliaceae; oil is used in cooking, medicine, soap etc.

(c) **Coconut oil :** It is obtained from the dry Kernel of the seed of *Cocos nucifera* - family Palmae; oil is used for cooking, as hair oil, and in the manufacture of soaps, shampoo, cosmetics etc.

(d) **Mustard oil :** It is obtained from the seeds of *Brassica campestris* - family Cruciferae; oil is chiefly used for cooking purposes.

(e) **Castor oil :** It is obtained from the seeds of *Ricinus communis* - family Euphorbiaceae; oil is used in medicines, as lubricant and also in making soaps.

(f) **Soyabean oil :** It is obtained from the seeds of *Glycine max* - family Papilionaceae; raw oil is used in the manufacture of soap, varnishes, paints etc.; refined oil is used for cooking purposes.

(g) **Linseed oil :** It is obtained from the seeds of *Linum usitatissimum* - family Linaceae; oil is used in making paints, varnishes, soaps etc.

(5) **Pulses :** These are the members of family Leguminosae which is characterised by a type of fruit i.e., legume. Legumes or pulses are highly proteinaceous; they form excellent green manures as they are having root-nodules for nitrogen fixation. Some of the important pulses are as follows :

(i) **Pea** (*Pisum sativum*) **:** It is grown all over India during winter months. The plant is an annual herb climbing by means of tendrils. The seeds are eaten after cooking as vegetable; plants are used as valuable fodder.

(ii) **Gram or Chana** (*Cicer arietinum*) **:** It is cultivated all over India as an important pulse. The plant is a bushy annual and matures in about three months. The seeds are eaten as dal and the flour which is commonly called as besan is used in the preparation of sweets and other foodstuffs; the plants and seeds are also used as cattle feed.

(iii) **Pigeon pea or Red gram or Arhar** (*Cajanus cajan*) **:** It is widely cultivated in India and is grown as a pure crop or mixed crop. The plant is a perennial shrub. Dry grains are used as dal; leaves form a valuable fodder; branches are used for making baskets.

(iv) **Ground nut or Moongphali** (*Arachis hypogea*) **:** The plant is a bushy annual with underground fruits. Groundnuts are very nutritious as they are rich is proteins. Seeds are used after roasting for preparation of peanut butter; groundnut oil is largely used as cooking oil.

(v) **Black gram or Urd** (*Phaseolus mungo*) **:** It is the one of the best pulses grown all over India. The plant is a trailing annual. It is used as dal; flour is used in the preparation of papads and biscuits; seeds and straw form a valuable cattle feed.

(vi) **Soyabean** (*Glycine max*) **:** The seeds of this plant are the protein richest, natural vegetable food known. It is cultivated all over India. The plant is a small, bushy, erect or prostrate annual. It has 30-60% protein content. Seeds are used green or dry; soya milk, soya cheese etc. are prepared from the seeds; soyabean flour is used in bakery, ice cream etc.

(vii) **Green gram or Moong** (*Phaseolus radiatus*) **:** It is cultivated as an important pulse crop in Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar and Bengal. The green pods are eaten as vegetable and seeds are used as dal. The entire plant is used as cattle feed.

(6) **Medicinal Plants :** Most of the medicinal plants are wild; these plants are collected and sent to the centres of researches to work out their medicinal value. A good number of them are cultivated on commercial basis. Some of the important drug yielding plants are :

(i) **Opium** (*Papaver somniferum* - **family Papaveraceae**) **:** The plant is an erect herb having large globose capsules. Opium is the latex of unripe fruits. The opium contains several important alkaloids such as morphine, codeine, narcotine, thebaine, neopine etc. The opium has narcotic and sedative effect and is largely used to relieve pain as an intoxicant. Heroine is a derivative of opium (morphine).

(ii) **Rauwolfia** (*Rauwolfia serpentina* - **family Apocynaceae**) **:** It is an erect, perennial undershrub. The dried roots are an important source of an alkaloid reserpine and other alkaloids are serpentine, serpentinine, rauwolfine etc. The alkaloid reserpine is used in several patent drugs, as it has a depressant action on central nervous system and produces sedation and lowering of blood pressure.

(iii) **Cinchona** (*Cinchona officinalis* - **family Rubiaceae**) **:** It is a famous quinine-yielding plant. Quinine is the most important drug obtained from the bark of this plant and also from other species i.e., *C. ledgerina, C. officinalis* and *C. cordifolia*. Bark of these plants contains about 30 alkaloids including quinine, cinchonine, quinidine and cinchinidine, all of which are used in medicine. Quinine has been a great boon to mankind, as it is the only adequate cure for malaria.

(iv) **Belladona** (*Atropa belladona* - **family Solanaceae**) **:** Belladona drug is obtained from the leaves of this plant. The plant is a perennial herb. Belladona is used extremely to relieve pain; besides this leaves contain several alkaloids chief among which is atropine, used to dilate pupil of the eye.

(v) **Ephedrine** (*Ephedra equisetina* and *E. sinica* - **family Gnetaceae**) **:** *Ephedra* is a leafless shrub. The entire plant is used in the extraction of this drug. Ephedrine is used to cure asthma, colds and hay fevers.

(vi) **Aconite** (*Aconitum napellus* - **family Ranunculaceae**) **:** Aconite is obtained from the tuberous roots of this plant. Aconite relieves pain due to neuralgia, rheumatism and inflamed joints; it is also used as a tonic and sedative.

New world and Old world crops before 1492

New World	Old World	New World	Old World
Maize	Wheat	Papaya	Coconut
Potato	Rice	Avocado	Cabbage
Tapioca	Barley	Pineapple	Radish
Kidney bean	Oat	Custard apple	Carrot
Lima bean	Rye	Guava	Onion
Sunflower	Sorghum	Sapota	Garlic
Peanut	Lentil	Cashew	Spinach
Tomato	Pea	Cotton	Cucumber
Squash	Soyabean	Quinine	Brinjal
Pumpkin	Mustard	Cocoa	Beet
Red Pepper	Olive	Coca	Sugarcane

Some important Cereals and Millets

English name / Common name	Botanical name	Family
(A) Major cereals		
1. Wheat (Gehoon)	*Triticum vulgare = T. aestivum*	Poaceae (Gramineae)
2. Maize (Corn, Makka)	*Zea mays*	Poaceae
3. Rice (Dhaan, Chawal)	*Oryza sativa*	Poaceae
4. Barley (Jau)	*Hordeum vulgare*	Poaceae
5. Oat (Jai)	*Avena sativa*	Poaceae
6. Rye	*Secale cereale*	Poaceae
(B) Millets		
7. Finger millet (Ragi)	*Eleusine coracana*	Poaceae

8. Pearl millet (Bajra)	*Pennisetum typhoides*	Poaceae
9. Sorghum (Jowar)	*Sorghum vulgare*	Poaceae

Some important Legumes

Common name	Indian name	Botanical name	Special features
1. Pigeon pea/Red gram / Congo pea	Arhar	*Cajanus cajan* (= *C. indicus*)	Seeds extensively used in the form of split pulse (dal) especially in South India.
2. Chick pea / Bengal gram/ Gram / Garbanzos	Chana	*Cicer arietinum*	Seeds eaten raw, roasted, or boiled in the form of dal; Flour called besan, plus ghee and sugar used for making sweets.
3. Cluster bean	Guar	*Cyamopsis tetragonoloba*	Young tender pods used as vegetables.
4. Horse gram	—	*Dolichos uniflorus*	Poor man's pulse in South India; Often used as feed for cattle and horses.
5. Hyacinth bean	Sem	*Dolichos lablab*	Young pods and tender beans used as vegetables
6. Chickling vetch / grass pea	Khesari dal	*Lathyrus sativus*	Cheapest pulse; consumed by poor classes in India. Serious disease Lathyrism (paralysis of lower limbs) results from excessive and prolonged consumption of khesari dal. The seeds contain osteotoxin B–amino propronitrile (BPN) and water soluble neurotoxin B–N–oxalyl amino alamine (BOAA).
7. Lentil	Masoor, Malka masoor	*Lens esculenta/ Lens culinaris*	Most nutritious of all pulses; Protein content high, proteins easily digestible; unripe pods used as green vegetable.
8. Common bean / French bean / Kidney bean	Vilayati sem	*Phaseolus vulgaris*	Green immature pods used as vegetable. Straw used as cattle feed.
9. Black gram	Urd	*Phaseolus mungo* (=Vigna mungo)	Rich in phosphoric acid, used as dal; used with rice for idli and dosa. Chief constituent of Papar and Vari.
10. Green gram / Golden gram	Mung	*Phaseolus aureus / P. radiatus (Vigna radiata)*	Used as dal; seeds fried and salted used as snacks.
11. Moth bean	Moth	*Phaseolus aconitifolius*	Young pods eaten as vegetable. Ripe seeds eaten as dal.
12. Pea	Matar	*Pisum sativum*	Seeds used as vegetable after cooking or mixed with various vegetables.
13. Cow pea	Lobia	*Vigna unguiculata (= V. sinensis)*	Seed eaten cooked as vegetable; immature pods also cooked as vegetables.
14. Soyabean	Soyabean	*Glycine max (= G. soja = G. hispida = Soja max)*	Seeds richest in protein; Grinding boiled seeds with water yields soyabean milk (nutritious like cow's milk, fit for infants) Soya–sauce is obtained by fermenting soyabean and rice flour with *Aspergillus oryzae*.

Some important Fruits

Common Name	Indian name	Botanical name & Family	Special features

1. Lime	(a) Kaaghzi Nimbu (b) Nimbu	*Citrus aurantiifolia* (Rutaceae) *C. aurantiifolia* var. *bergamia*	Hesperidium; Citric acid in fruits, Hesperidium; Unripe fruit is digestive,
2. Sour or Seveille orange	Khatta	*Citrus aurantium var. bigardia* (Rutaceae)	Hesperidium; Rich in provitamins A and B.
3. Sweet orange	Mausambi/Malta	*Citrus sinensis* (Rutaceae)	Hesperidium; Fruit juice quenches thirst, improves apetite, given to patients;
4. Mandarin orange/ Tangerine	Santara	*Citrus reticulata*	Hesperidium; Highly nutritious, rich in calcium;
5. Shaddock/Pummelo	Chakotra	*Citrus maxima C. grandis* (Rutaceae)	Hesperidium; Fruits edible, neither sour nor bitter;
6. Grape fruit	—	*Citrus paradisi* (Rutaceae)	Hesperidium; Canned and frozen;
7. Apple	Sev	*Malus pumila (=Pyrus malus = Malus sylvestris)* (Rosaceae)	Pome; Fleshy thalamus edible, Malic acid is chief acid; characteristic smell due to esters and essential oils.
8. Apricot	Khubani	*Prunus armeniaca* (Posaceae)	Drupe, Epicarp and mesocarp edible.
9. Peach	Aroo	*Prunus persica* (Rosaceae)	Drupe; eaten raw, also canned
10. Pear	Nashpati	*Pyrus communis* (Rosaceae)	Pome; rich in sugar, eaten raw and canned
11. Plum	Alucha	*Prunus domestica* (Rosaceae)	Drupe; Epicarp and mesocarp edible.
12. Japanese Medlar	Loquat	*Eriobotrya japonica* (Rosaceae)	Mesocarp edible, Drupe
13. Mango	Aam	*Mangifera indica* (Anacardiaceae)	Drupe; Fleshy mesocarp edible, eaten raw; pickled, jams prepared, important source of vitamins A.
14. Banana	Kela	*Musa sapientum = M. paradisiaca* (Musaceae)	Berry; good source of vitamins A, C; rich in minerals and sugars
15. Custard apple	Sharifa	*Annona squamosa*	Etaerio of berries, fruit eaten fresh
16. Cherimoya	Hanumanphal	*Annona cherimola* (Annonaceae)	Etaerio of berries, fruit eaten fresh
17. Pineapple	Ananas	*Ananas comosus* (Bromeliaceae)	Sorosis; fleshy axis, bracts, perianth and seeds edible.
18. Date palm	Khajur	*Phoerix dactylifera* (Palmae)	Drupe; rich in sugars, a fermented drink (toddy) is prepared from the sap.
19. Grapes	Angoor	*Vitis vinifera* (Vitaceae)	Berry; eaten raw, used for making raisins and wine 18–25% sugar-mostly glucose and fructose.
20. Guava	Amrood	*Psidium guajava* (Myrtaceae)	Berry cheap and rich source of vitamin C and calcium.
21. Jumbolan	Jamun	*Syzygium cumini (=Eugenia jambolana)* (Myrtaceae)	Berry; seeds useful in diarrhoea, dysentry and diabetes.
22. Litchi	Litchi	*Litchi chinensis (Sapindaceae)*	One-seeded nut; fleshy aril of seed edible.
23. Mulberry	Shehtoot	*Morus alba* (Maraceae)	Sorosis, juicy inflorescence edible; silkworm reared on leaves.
24. Fig	Anjeer	*Ficus carica* (Moraceae)	Syconus; fruit edible.
25. Muskmelon	Kharbuja	*Cucumis melo* (Cucurbitaceae)	Pepo; fruit eaten raw.
26. Watermelon	Tarbooz	*Citrulus vulgaris* (Cucurbitaceae)	Pepo; fruit eaten raw.
27. Papaya	Papeeta	*Carica papaya* (Caricaceae)	Berry; Raw fruit eaten; contains proteins, minerals, vitamins and

			enzyme papain
28. Pomegranate	Anaar	*Punica granatum* (Punicaceae)	Berry; with edible aril, Dried seeds (anardana) used as flavouring substance.
29. Phalsa	Phalsa	*Grewia asiatica (Tiliaceae)*	Drupe, eaten raw
30. Jujube	Ber	*Zizyphus mauritiana* (Rhamnaceae)	Drupe, eaten raw.
31. Emblic	Amla	*Emblica officinalis (=Phyllanthus emblica)* (Euphorbiaceae)	Rich in vitamin C, used for controlling indigestion.
32. Wood-Apple	Bael	*Aegle marmelos* (Rutaceae)	The ripe fruits is aromatic, used as laxative.

Some common Vegetables

English Name	Hindi name	Botanical name & Family	Special remarks
A. Root Vegetables			
1. Beets	Chukander	*Beta vulgaris* (Chenopodiaceae)	Roots and leaves used as salad and vegetables.
2. Carrot	Gajar	*Daucus carota* (Umbelliferae)	Used as salad and vegetable, contains carotene A precursor of Vitamin A.
3. Radish	Moolee	*Raphanus sativus* (Cruciferae)	Used as salad; leaves used as vegetable; rich in vitamins A and C.
4. Turnip	Shaljam	*Brassica rapa* (Cruciferae)	Characteristic flavour due to presence of volatile is othiocyanates used as salad and vegetable.
5. Sweet potato	Shakarkandi	*Ipomoea batatas* (Convolvulaceae)	Tuberous root edible, good raw material for industrial alcohol, starch and glucose.
6. Cassava / Tapioca	Saakarkand	*Manihot esculenta* =*M. utilissima* (Euphorbiaceae)	Tubers rich in calcium and vitamin C alongwith starch source of tapioca starch; staple food of many people; in India concentrated on west coast especially in Kerala.
B. Underground Stems			
7. Garlic	Lahsun	*Allium sativum* (Liliaceae)	Pungent smell due to allicin-antiseptic and bactericide-used as flavouring vegetables.
8. Onion	Pyaz	*Allium cepa* (Liliaceae)	Fleshy leaves of bulb rich in minerals and vitamins; eaten raw with meals; added to dals.
9. Potato	Aaloo	*Solanum tuberosum*	Cheap source of starch, excellent

		(Solanaceae)	source of vitamin C and minerals.
10. Taro	Arvi	*Colocasia esculenta*	Rhizome starchy, tuberous, edible.
11. Artichoke	Hathichuk	*Helianthus tuberosus* (Compositae)	Edible tuberous stem underground; source of levulose-sweetening agent used by diabetics.
C. Herbage Vegetables			
12. Cabbage	Band Gobhi	*Brassica oleracea var. capitata* (Cruciferae)	Vegetative bud consisting of compaction of leaves edible eaten raw or cooked.
13. Cauliflower	Phoolgobhi	*Brassica oleracea var. botrytis* (Cruciferae)	Inflorescence comprises hypertrophied flower stalks and abortive flowers eaten after cooking.
14. Lettuce	Salad	*Lactuca sativa* (Compositae)	Leaves eaten as salad; rich in vitamins A and E.
15. Spinach	Palak	*Spinacea oleracea* (Chenopodiaceae)	Compact rosette of leaves eaten cooked; rich in vitamin A and minerals.
16. Celery	Celera	*Adium graveolens var. dulce* (Umbelliferae)	Leaf stalks contain good quantities of starch, used in salads, stews and soups.
17. Asparagus	—	*Asparagus officinale* (Liliaceae)	Shoots (Cladodes) consumed green; rich source of vitamins A, B_1, B_2 and C.
D. Fruit Vegetables			
18. Tomato	Tamatar	*Lycopersicon esculentum (= Solanum lycopersicum)* (Solanaceae)	Salads and cooked vegetables; Rich in Vitamin C, A, B, B_2
19. Brinjal/Egg plant	Baingan	*Solanum melongena* (Solanacea)	Fruit cooked as vegetable; rich in iodine.
20. Lady's finger/Okra	Bhindi	*Abelmoschus esculentus* = *Hibiscus esculentus* (Malvaceae)	Unripe fruit cooked as vegetable.
21. Cluster bean	Guar	*Cyamopsis tetragonoloba* (Papilionaceae)	Immature green pods seeds edible; guar gum from seed.
22. Hyacinth bean	Sem	*Lablab purpureus (=Dolichos lablab)* (Papilionaceae)	Green pods and seeds eaten as vegetable.
23. Wax or white gourd	Petha	*Benincasa hispida*	Confectionery and vegetable.

		(Cucurbitaceae)	
24. Squash melon	Tinda	*Citrullus lanatus var. fistulosus* (Cucurbitaceae)	Cooked as vegetable.
25. Snapmelon	Phoot, kachra	*Cucumis melo var. momordica* (Cucurbitaceae)	Cooked as vegetable.
26. Long melon or Snake cucumber	Kakri or Tar	*Cucumis melo var. utilissimus* (Cucurbitaceae)	Salad.
27. Cucumber	Kheera	*Cucumis sativus* (Cucurbitaceae)	Salad.
28. Winter squash	Vilayati Kaddu	*Cucurbia maxima* (Cucurbitaceae)	Cooked vegetable.
29. Pumpkins	Sitaphal, Halwa Kaddu or Kanshiphal	*Cucurbita moschata*	Cooked vegetable and sweet.
30. Summer squash or Marrow	Chappan kaddu	*Cucurbita pepo* (Cucurbitaceae)	Cooked as vegetable.
31. Bottle gourd or Calabash	Lauki, ghia	*Lagenaria siceraria* (Cucurbitaceae)	Cooked vegetable and containers.
32. Ridged or Ribbed sponge gourd, dishcloth gourd	Kali tori	*Luffa acutangula* (Cucurbitaceae)	Cooked vegetable.
33. Smooth sponge gourd or Loofah	Ghia tori	*Luffa cylindrica* (Cucurbitaceae)	Cooked vegetable and sponges for bath.
34. Bitter gourd or balsam pear	Karela	*Momordica charantia* (Cucurbitaceae)	Cooked vegetables and pickles.
35. Pointed gourd	Parwal, parmal	*Trichosanthes dioica* (Cucurbitaceae)	Cooked vegetable.

Some important Nuts

Common name	Hindi name	Botanical name (Family)	Special features
1. Cashewnut	Kaajoo	*Anacardium occidentale* (Anacardiaceae)	Kidney - shaped seeds present in kidney shaped nuts (cashew nut) borne on juicy pear-shaped fruit (cashew apple). The seed eaten raw or roasted. Cashew apple juice fermented to make cashew wine.
2. Walnut	Akhrot	*Juglans nigra* (Juglandaceae)	(a) Kemels eaten as such or added to confectionary and ice creams, custards etc. (b) Tree bark used as dundasa for cleaning teeth.
3. Almond / Sweet almond	Badam	*Prunus dulcis (= Prunus amygdalus var. dulcis)* (Rosaceae)	Seeds eaten raw, added to confectionary, custard etc. Badam roghan - an oil extracted from sweet almond is medicinally important.
4. Bitter almond	Karua	*Prunus amygdalus var.*	Contain bitter poisonous glucoside-amygdalin.

	badam	*amara* (Rosaceae)	
5. Pistachio nut/ Green almond	Pistaa	*Pistacia vera* (Anacardiaceae)	Kernels eaten salted, roasted used for decorating and flavouring confectionary, ice creams etc.
6. Coconut	Nariyal/Gola	*Cocos nucifera* (Palmae)	Kernel called copra; yields coconut milk; food and oil from kernel.
7. Pinenut	Chilogja/Neja	*Pinus gerardina* (Pinaceae)	Edable part is kernel.

Some important Essential oils

Common Name	Hindi name	Botanical name	Special features
1. Jasmine oil	Juhi	*Jasmine auriculatum* (Oleaceae)	Fragrant flowers yield jasmine oil used in perfumed oils and attars.
2. Khas Khas oil	Khus Khus	*Vetiveria zizanioides* (Gramineae)	Roots yield a khus khus oil used in perfumes, soaps, sherbets; roots used for mats for air coolers.
3. Lavender		*Lavandula angustifolia* (Labiatae)	Flowers yield oil for perfumes, toilet soaps, toilet ponders, Lavender water etc.
4. Rose oil	Gulab	*Rosa damascena* (Rosaceae)	Petals yield oil or roses, used in rose water attar; petals used for gulkand.
5. Sandalwood oil	Chandan	*Santalum album* (Santalaceae)	Heartwood yields oil, roots also are rich source of oil; oil used for toilet soaps, face creams, perfumery and also religious ceremonies.
6. Camphor	Kapoor	*Cinnamomum camphora* (Lauraceae)	Wood yields camphor (camphor gum) used in perfumery and medicines.
7. Lemongrass oil		*Cymbopogon citratus* (Graminaee)	Leaves yield oil which contain citral; used in manufacturing perumes (lonone), soaps, cosmetics etc.
8. Eucalyptus oil		*Eucalyptus globosus* (Myrtaceae)	Dried leaves yield oil used for perfumery, treatment of asthma and bronchitis.
9. Cedarwood oil		*Juniperus macropoda* (Pinaceae)	Heart wood yields oil used for perfumery, clearing agent in the preparation of microscopic slides.
10. Peppermint oil		*Mentha piperata* (Labiatae)	Leaves yield oil used in perfumery.
11. Champaca oil		*Michelia champaca* (Magnoliaceae)	Flowers yield oil used in perfumery.
12. Clove oil		*Syzygium aromaticum* (Myrtaceae)	Unopen flower buds yield oil used in perfumes and medicines.
13. Geranium oil		*Pelargonium graveolens*	Oil from leaves used in perfumery.

Some Fatty oils yielding plants

Common name	Hindi name	Botanical name	Special features
1. Coconut	Nariyal	*Cocos nucifera* (Palmae)	Endosperm yields coconut oil used as cooking oil, hair oil, etc.
2. Mustard	Sarson	*Brassica campestris*	Oil from seeds used in cooking, pickes; oil cake

		var. sarson (Cruciferae)	used as cattle feed.
3. Ground nut	Moongphali	*Arachis hypogea* (Papilionaceae)	Seed (cotyledones) yield non-drying oil used as cooking medium; large quantities used for manufacturing vegetable ghee; oil cake used as cattle feed.
4. Safflower	Kusum	*Carthamus tinctorius* (Compositae)	Seed oil edible, rich in PUFA (poly unsaturated fatty acid), prescribed for heart patient, for it does not increase cholesterol; flowers yield dye used to colour foods and cloth.
5. Sesame, Gingelly	Til	*Sesamum indicum* (Pedaliaceae)	Seed oil used as cooking medium; oil cake used as cattle feed; defatted seeds are rich source of protein.
6. Soyabean	Soyabean	*Glycine max* (Papilionaceae)	Seed oil is edible; germinated seeds rich in vitamin C Soymeal rich in proteins; lecithin-a, by-product of oil industry, used as stabilising agent in cosmetics, medicines, plastics etc.
7. Sunflower	Surajmukhi	*Helianthus annuus* (Compositae)	Seeds yield an oil; used as cooking medium; oil cake used as cattle feed.
8. Oil palm/African oil palm	—	*Elaeis guineensis* (Palmae)	The fleshy mesocarp of the fruits yields edible oil which is also used in the manufacture of soaps, candles, lubricants as well as a fuel for internal combustion engines.
9. Castor	Arandi	*Ricinus communis* (Euphorbiaceae)	Seeds yield oil used as purgative lubricant and in soap industry.
10. Cotton	Kapas	*Gossypium* sp. (Malvaceae)	Seeds yield oil used for cooking.
11. Linseed	Alsi	*Linum usitatissimum* (Linaceae)	Seeds yield oil forming a tough elastic film on oxidation; used for making paints and printing inks.
12. Olive	Jaitoon	*Olea europea* (Oleaceae)	Fruits yield edible oil.

Some more Fibre-yielding Plants

Common name	Hindi name	Botanical name and Family	Special features
1. Flax	Alsi	*Linum usitatissimum* (Linaceae)	Pericycle fibres : soft/bast, used for bags, ropes, carpets paper.
2. Sunn hemp	Sunn	*Crotolaria juncea* (Leguminosae)	Fibres from region outside cambium used for canvas, rope, nets.
3. Hemp	Bhang	*Cannabis sativus* (Cannabinaceae)	Fibres from bark; used for brush, ropes, carpets, cordage, sacks, bags.

4. Munja	Munj	*Saccharum munja* (Poaceae)	Fiber from stem and leaves, lower part of stem used for making furniture; upper part for cordage, baskets.
5. Coir	Nariyal	*Cocos nucifera*	Fibrous mesocarp – Hard fibre used for coir, rope, mats, carpets. India principal producer (Mainly Kerala).
6. Kenaf/Deccan hemp/Java jute	—	*Hibiscus cannabinus* (Malvaceae)	Fibres from lower part of the stem; used for bags, sacks, cordage, nets, substitute for jute.
7. Ramie/China grass	—	*Boehmeria nivea* (Urticaceae)	Toughest, longest, strongest most durable fibre present in Secondary phloem; used for brush, ropes, carpets, cordage bags, chinese linen.
8. Abaca /Manila hemp	—	*Musa textilis* (Musaceae)	Strongest of all structure fibres. Leaf sheath contains fibres, used for marine cordage, fishing industry.
9. Sisal	—	*Agave sisalana* (Agavaceae)	Leaves contain fibres; used for carpet backing bags, industrial fabrics.
10. Kapok	—	*Bombax pentantrum* (Bombacaceae)	Inner wall of fruit contains fibres; used for stuffing mattresses, pillow, cushions, life belts, life jackets.
11. Red silk cotton	Semal	*Salmalia malabarica*	Seed hairs, substitute for kapok.
12. Cotton	Kapas	*Gossypium* sp. (Malvaceae)	
13. Jute	Jute	*Corchorus capsularis, C. olitorius* (Tiliaceae)	
14. Broomcorn		*Sorghum vulgare var. technicum* (Poaceae)	

Some important Commercial woods

Common Name	Hindi name	Botanical name and Family	Special features
1.Sisso/Indian redwood	Sheesham	*Dalbergia sisso* (Papilionaceae)	Finest wood for cabinet and furniture, used for railway sleepes, musical instruments, tobacco pipes, and also for charcoal making.
2. Ebony	—	*Diospyrous ebenum* (Ebenaceae)	For decorative work, piano keys, handles of cutlery, chess pieces, walking sticks, flutes etc.
3. Sal	Sal	*Shorea robusta* (Dipterocarpaceae)	Ranks second to teak; used for construction work, eminently suited for sleepers.
4. Mahogany	—	*Swietenia mahagoni* (Meliaceae)	Light reflecting quality; used for furnitures, aeroplane propellers; ship building.
5. Teak	Saguan	*Tectona grandis* (Verbenaceae)	Railway carriage, House construction, ships, bridge, Toys, Plywood, Boats etc.; extremely durable and hard.

6. Cedar	Deodar	*Cedrus deodara* (Pinaceae)	Most strong Indian soft wood, Railway sleepers, doors, windows.
7. Pinewood	Chir	*Pinus roxburghi, Pinus* sp.	Packing cases, Railway sleepers, Match industry.
8. Birch	Bhojpatra	*Betula alnoides* (Betulaceae)	Plywood, furniture.
9. Balsa	—	*Ochroma pyramidale*	Lightest commercial wood, used as sandwitch material for gliders, etc.
10. Sandalwood	Chandan	*Santalum album* (Santalaceae)	Boxes, toys, religious ceremonies.

Some important Resin-yielding Plants

Common name	Botanical name	Special features
1. Kala damar	(a) *Shorea tumbuggaia* (Dipterocarpaceae) (b) *Canarium sirictum* (Burseraceae)	Resin from stem; used for incense. Used in preparing varnishes and medical plasters.
2. White damar	*Vateria indica* (Dipterocarpaceae)	Resin from trunk used as an incense, and in paints and varnishes.
3. Lacquer	*Rhus vernicifera* (Anacardiaceae)	Applied as varnish.
4. Asafoetida (Hing)	*Ferula asafoetida* (Umbelliferae)	Powerful, pungent odour, bitter taste, used in perfumery and as flavouring agent, antihelmintic.
5. Turpentines	*Pinus roxburghi* (Pinaceae)	Varnishes, paints etc.

Common beverages

Common name	Source Plant and Family	Special features
A. Alcoholic Beverages		
1. Beer (From barley malt)	*Hordeum vulgare* (Gramineae)	Barley malt used; alcohol 3–6%.
2. Brandy (From wine grapes)	*Vitis vinifera* (Vitaceae)	Fermented and distilled juice; alcohol content 60–70%.
3. Rum (From molasses, sugar cane juice)	*Saccharum officinarum* (Gramineae)	A distilled beverage; alcohol content about 40%.
4. Whisky (From malted or unmalted cereals or potatoes)	—	Distilled alcohol, alcohol content about 50%.
B. Non-Alcoholic Beverages		
5. Cocoa	*Theobroma cacao* (Sterculiaceae)	Seeds used for non-alcoholic beverage; butter from seeds used for making chocolates.

6. Coffee	*Coffea arabica* (Rubiaceae)	Dried beans (seeds) roasted, ground and brewed to make stimulating beverage; caffeine is main alkaloid.
7. Tea	*Camellia sinensis* (Theaceae) (=*Thea sinensis*)	Cured leaves used as beverage; it contains 2–5% theine (alkaloid).

Important Spices and Condiments

Common name	Hindi name	Source Plant and Family	Special features
1. Black pepper	Kali mirch	*Piper nigrum* (Piperaceae)	Fruits used as condiments; also used medicinally as stimulant, carminative and stomachic.
2. Caraway	Jeera	*Carum carvi* (Umbelliferae)	Fruits used as condiment, medicinally as stomachic and carminative.
3. Cardamomum	Chhoti elaichi	*Elettaria cardamomum* (Zingiberaceae)	Dried fruits used as condiment, in paan; as flavouring agent; in medicine as stimulant and carminative.
4. Cardamomum	Indian Bari elaichi	*Ammomum aromaticum* (zingiberaceae)	Seeds used as flavouring agent; seed oil stimulant and stomachic.
5. Cassie	Tejpat	*Cinnamomum tamala* (Lauraceae)	Dried leaves used as condiment; leaves are carminative and used in colic and diarrhoea.
6. Chillies, Red pepper	Mirch, Lal mirch	*Capsicum annuum* (Solanaceae)	Fruits green and ripe used as condiment; fruits used as pickle, powerful stimulant and carminative. Good source of vitamin C.
7. Cloves	Laung	*Syzygium aromaticum* (Myrtaceae)	Dried (unopened) flower buds used as spice; clove bud oil useful in tooth pain; also as clearing agent in biology laboratory.
8. Coriander	Dhania	*Coriandrum sativum* (Umbelliferae)	Fruits and leaves are used as condiment; used as flavouring agent also.
9. Cinnamon	Dalchini	*Cinnamonum zeylanicum* (Lauraceae) (=*C. verum*)	Dried inner bark used for its delicate fragrance and sweet taste.
10. Ginger	Adrak	*Zingiber officinale* (Zingiberaceae)	Rhizomes used as pice and condiment as well in medicine.
11. Nutmeg	Jaiphal	*Myristica fragrans* (Myristicaceae)	Nutmeg (kernel) and mace (aril) used as colouring and flavouring agents.
12. Saffron	Kesar, Jaffran	*Crocus sativus* (Iridaceae)	Stigmas and tops of styles are used as colouring and flavouring agents.
13. Turmeric	Haldi	*Curcuma domestica* (Zingiberaceae)	Rhizomes used for seasoning of food and as condiment; medicinally used as stomachic, tonic, blood purifier and antiseptic; also used as colouring agent.
14. Fennel	Saunf	*Foeniculum vulgare* (Umbelliferae)	Used as flavouring agent for soups, confectionaries; fennel oil used in infantile colic,

			flatulence; good vermicide.
15. Vanilla	—	*Vanilla planifolia* (Orchidaceae)	Characteristic flavour due to vanillin, flavouring agent for ice creams, soft drinks, confectionary.

Some important Fumitories and Masticatiories

Common name	Hindi name	Source Plant and Family	Special features
1. Tobacco	Tambakhu	*Nicotiana tabacum* (Solanaceae)	Leaves contain nicotine; mild stimulant, causes lung cancer and atherosclerosis of coronoary arteries; accelerates heart beat, increases hypertension and bronchial cough.
2. Kola	—	*Cola nitida* (Stercuiliaceae)	Seeds used as masticatory, contain glycoside kolanin and alkaloid caffeine.
3. Areca nut	Supari	*Areca catechu l* Betel nut palm (Palmae)	Endosperm of the nut used as masticatory alongwith betal (paan); used as vermifuge for tapeworm in veterinary practice.
4. Betal, Paan	—	*Piper betel* (Piperaceae)	The leaves provide famous paan.
5. Coca	Cocain	*Erythroxylon coca* (Erythroxylaceae)	Leaves contain cocaine; it is chewed with morphine or heroin called speed ball; acts on central nervous system causing psychic exaltation; reduces apetite; physical and mental deterioration leads to death.
6. Hemp Indian	Ganja, Bhang	*Cannabis sativa* (Cannabinaceae)	Female flowers used for extraction of hallucinogenic narcotics-hashish, charas, marijuana, bhang, ganja, etc. alter thoughts, feelings and perceptions; causes addiction.
7. Opium	Afeem	*Papaver somniferum* (Papaveraceae)	Latex from unripe capsules yields alkaloid morphine.

Some important Medicines and their source plants

Common name	Hindi name	Source Plant & Family	Special features
1.Quinine, Cinchona	Kunain	*Cinchona officinalis* (Rubiaceae)	Bark of trunk is a source of quinine used for treatment of malarial fevers.
2. Wormseed	Kirmala	*Artemisia maritima* (Compositae)	Flower heads yield santonin used to expel threadworms and roundworms.
3. Withania, Asgand, Punir	Ashwagandha	*Withania somnifera* (Solanaceae)	Roots used for general weakness and rheumatism, it is diuretic and promotes urination; roots and leaves antibacterial.
4. Belladonna, Night shade	Sag-angur Angurshefa	*Atropa belladonna* (Solanaceae)	Leaves used as tonic, antispasmodic and sedative, atropine- an alkaloid obtained from leaves is used in eye-testing and treatment.
5. Malabar nut	Vasaka	*Adhatoda vesica* (Acanthaceae)	Fresh/dried leaves constitute the drug vasaka used in bronchial troubles. Active principle – vascin.
6. Camphor	Kapur	*Cinnamomum camphora* (Lauraceae)	Wood yields camphor used in inflammations, rheumatic pain and sprains; and internally in diarrhoea; and as cardiac stimulant.

7. Foxglove	Tilpushpi	*Digitalis purpurea* (Scrophulariaceae)	Dried leaves yield glucoside digitoxin useful for regulating tone and rhythm of heart, used in ointments for application of burns and wounds.
8. Epheda	Khanda	*Ephedra gerardiana* (Ephedraceae)	Dried stem yields ephedrine useful against asthma, cold, inflamation of mucous membrane; also used as cardiac stimulant and against allergenic rashes.
9. Aconitum; Monks hood	Balnag	*Aconitum napellus* (Ranuculaceae)	Roots yield the drug `aconite' used for rheumatism and as nerve sedative externally for rheumatism and internally to relieve pain cough, asthma and fever.
10. Garlic	Lahsun	*Allium sativum* (Liliaceae)	Used in intestinal disorder, cough, lever, in colitis and dilation of coronary arteries.
11. Ginseng	—	*Panax schinseng* (Araliaceae)	Gingseng root is used as stimulant and stomachic, it reduces high blood pressure and raises low blood pressure.
12. Ipecae	—	*Cephaelis ipecacuanha* (Rubiaceae)	Annulated rhizomes yield cephaeline used as emetic and expectorant, also in treatment of amoebic dysentery and pyrrhoea.
13. Licorice, Liquorice	Mulhatti	*Glycyrrhiza glabra* (Papilionaceae)	Glycyrrhizin, a glycoside in root used for treating gastric ulcers, cough and sore throat.
14. Nuxvomica/ Strychnine Kuchla	—	*Strychnos nuxvomica* (Loganiaceae)	Seeds yield a drugh nux-vomica, used in low doses as tonic stimulant and in treatment of paralysis and nervous disorders. Higher doses used for killing stray dogs and pets.
15. Psyllium, lsabgol	—	*Plantago ovata* (Plantaginaceae)	Tasteless substances in seeds acts as a mild laxative; used in the treatment of dysentery and other disorders of digestive system.
16. Opium	Afeem (Afim)	*Papaver somniferum* (Papaveraceae)	Milky latex from capsule yields alkaloids especially morphine used to reduce blood pressure, bleeding; to treat diarrhoea vomitting; and in cough medicines.
17. Rauwolfia	Sarpagandha	*Rauwolfia serpentina* (Apocynaceae)	Roots bark yield alkaloid reserpine-used for treatment of schizophrenia and other mental disorders; widely employed for treating high blood pressure.
18. Ironwood	Nagkesar	*Mesua ferrea* (Guttiferae)	Flowers used for cough; buds in dysentry.
19. Indian Aloe	Gheegwar	*Aloe vera* (Liliaceae)	Leaves use in fever, enlargement of liver, Skin disease, Piles, Jaundice.

Some other useful plants

English /Common name	Botanical name	Family	Uses
1. Para rubber	*Hevea brasiliensis*	Euphorbiaceae	Widely utilized in manufacture of tyres, tubes and other articles, used in sports, medical instruments, agriculture, etc.
2. Indian rubber	*Ficus elastica*	Moraceae	Used for manufacture of various articles.
3. Chickle	*Achras sapota*	Sapotaceae	Used in chewing-gum.

4. Babul (Kikar)	*Acacia nilotica*	Mimosaceae	Gum edible and used in medicines, printing, paints, etc; wood is used as fuel.
5. Catechu (Kathha)	*Acacia catechu*	Mimosoidae	Tannin obtained from heart wood and bark used in paan (betal); and for dyeing cloth.
6. Cork oak	*Quercus suber*	Fagaceae	Cork used as bottle stoppers, soles for shoes, insulating material; for manufacture of linoleum.
7. Henna (Mehndi)	*Lawsonia inermis*	Lythraceae	Leaves yield dye used as mehndi
8. Indigo (Nil)	*Indigofera tinctoria*	Fabaceae	A source of indigo
9. Orchill	*Rochella tinctoria*	Lichens	Source of orcein stain, used for cytological work.
10. Logwood (Patang)	*Haematoxylon campechianum*	Mimosaceae	Heartwood yields a dye hematoxylin; used to dye cloth; also useful as nuclear stain in biological laboratories.
11. Sugarcane (Ganna)	*Saccharum officinarum*	Poaceae	Cane juice is used for preparing gur and jaggery, sugar, etc; baggase used as fuel and in the manufacture of paper.
12. Beet root (Chukandar)	*Beta vulgaris*	Chenopodiaceae	Roots are source of sugar; tops and pulps are used as stock feed.
13. Neem tree	*Azadirechta indica*	Meliaceae	The fresh Juice of the leaves is given for the treatment of intestinal worms with honey the Juice is used for Jaundice and skin diseases. Its leaves are used as an antiseptic.
14. Tulsi	*Ocimum sanctum*	Labiatae	The leaves are aromatic their decoction is given in malaria gastric diseases of children check vomiting.
15. Ammi (Azwain)	*Trachyspermum ammi*	Apiaceae	It is used in gastric trouble bronchitis, as purgative etc.
16. Chembalic Myrobalan (Harra)	*Terminalia chebula*	Combrtaceae	As a constituent of 'Trifla'.

Some important Legumes

English name / Common name	Botanical name	Family
1. Black gram (Urd)	*Phaseolus mungo = Vigna mungo*	Fabaceae (Papilionaceae)
2. Cajan, Pigeon pea (Arhar)	*Cajanus cajan*	Fabaceae
3. Cow pea (Lobia)	*Vigna unguiculata = V. sinensis*	Fabaceae
4. Gram, Chick pea (Chana)	*Cicer arietinum*	Fabaceae
5. Green gram (Moong)	*Phaseolus aureus = Vigna radiata*	Fabaceae
6. Lentil (Masoor)	*Lens esculenta*	Fabaceae
7. Pea (Matar)	*Pisum sativum*	Fabaceae
8. Soyabean (Soyabean)	*Glycine max*	Fabaceae
9. French bean	*Phaseolus vulgaris*	Fabaceae
10. Moth bean	*Phaseolus aconitifolius*	Fabaceae

11. Cluster bean	*Cyamopsis tetrogonoloba*	Fabaceae

Some Fibre yielding plants

English name / Common name	Botanical name	Family
1. Cotton (Kapas)	*Gossypium* sp.	Malvaceae
2. Flax (Alsi)	*Linum usitatissimum*	Linaceae
3. Jute	*Corchorus capsularis, C. olitorius*	Tiliaceae
4. Coir (Nariyal)	*Cocos nucifera*	Arecaceae
5. Broomcorn	*Sorghum vulgare var. technicum*	Poaceae
6. Kapok	*Ceiba pentandra*	Bombacaceae
7. Sunn hemp	*Crotolaria juncea*	Fabaceae
8. Hemp (Bhang)	*Cannabis sativa*	Cannabinaceae
9. Munj	*Saccharum munja*	Poaceae
10. Ramie	*Boehmeria nivea*	Urticaceae
11. Manila hemp (Abaca)	*Musa textiles*	Musaceae

Some important Essential oils and Fatty oils

English name / Common name	Botanical name	Family
(A) Essential oils (Volatile oils)		
1. Jasmine (Juhi)	*Jasminum auriculatum*	Oleaceae
2. Khas Khas (Vetiver)	*Vetiveria zizunoides*	Poaceae
3. Lavender	*Lavandula officinalis*	Lamiaceae
4. Rose (Gulab)	*Rosa damascena*	Rosaceae
5. Sandalwood (Chandan)	*Santalum album*	Santalaceae
6. Geranium	*Pelargonium graveolens*	Lamiaceae
(B) Fatty oils (Non-volatile oils)		
7. Coconut (Nariyal)	*Cocos nucifera*	Arecaceae (Palmae)
8. Mustard (Sarson)	*Brassica campestris var. sarson*	Brassicaceae
9. Ground nut (Moonghphali)	*Arachis hypogaea*	Fabaceae
10. Safflower (Kusum)	*Carthamus tinctorius*	Asteraceae
11. Sesame (Til)	*Sesamum indicum*	Pedaliaceae
12. Soyabean	*Glycine max*	Fabaceae
13. Sunflower (Surajmukhi)	*Helianthus annuus*	Asteraceae
14. Castor (Arandi)	*Ricinus communis*	Euphorbiaceae

(7) **Petroleum and Oil producing plant :** Melvin Calvin was first to identify few petroleum plants – the plants whose products can be used in place of petrol and oil. Most of such plants

belong to families Asclepiadaceae, Euphorbiaceae and Apocynaceae. These plants are able to convert a subtantial amount of hydrocarbons into latex. *Euphorbia lathyrus* contains a mixture like terpen which can be converted into gasoline. Oil is also extracted from *Xanthagnum*.

2.2 Food preservation

In various seasons we have different varieties of vegetables, fruits, fish and meet. Their availability can be ensured through out the year only by preserving them. More over human diet includes a wide variety of substance which are rich in nutrients, thus serve as excellent media for microbial growth. Metabolic activities of micro organisms alter the condition of food resulting in 'spoilage'. Proteins are spoiled by *Pseudomonas proteus*. Carbohydrate foods are degraded by yeasts, *Streptococcus*. Fats are digested mainly by moulds. Therefore to protect food products from rotting, preservation is necessary. It has been estimated that every year about 30% of the total production of vegetables and fruits in India are perished due to lack of knowledge of food–preservation among the farmers. 'Preservation' not only makes food to remain fresh for a long time and makes storage possible, but it also provides employment to people and obtain a proper cost for the food products.

(1) **Methods of food-preservation :** Preservation is the technique used to protect food products for a longer duration, retaining its nutritive value as much as possible. The methods of food preservation used in food processing and food-preservation industries are canning & bottling, preparing jam, jelly, pickle, sauce and ketchups. The methods of food-preservation is generally of two types :

(i) **Temporary food-preservation :** This includes some simple methods by which food materials can be kept for a much longer time than usual but not for an indefinite period. Following are few important methods of temporary food preservation.

(a) **Pasteurization :** This method was devised by Louis Pasteur (1822-95). It is now been used as a temporary milk preservation method. In this method milk is heated in large tank at 62.9°C for 30 minutes and then cooled rapidly. This minimizes the population of bacteria, responsible for souring milk.

(b) **Low temperature storage :** By this method meet, fish, vegetables, fruits and milk products can be preserved. Two methods are employed in the preservation of food by cold temperature.

- **Chilling :** The temperature is kept just above the freezing point, e.g., preservation of butter, cheese.
- **Freezing :** Temperature around –25°C is maintained. e.g., preservation of mushrooms, meat etc.

(c) **Exclusion of air :** Air is one of the source of micro organisms and by avoiding content with air, food-materials can be preserved longer air tight containess are used for this purpose.

(d) **Exclusion of moisture :** Presence of moisture and warmth is conducive for the growth of micro–organisms. Therefore dehydrated food-materials should be packed in moisture proof

and air tight containers and polythene bags. Drying of food is necessary before its packing. Fruits and vegetables are dehydrated by three means *i.e.* by sun drying, oven drying and mechanical drying. Mushrooms are first immersed in boiling water for 3 minutes and immediately dipped in cold water to destroy enzymes (The process is called 'Blomching') and then subjected to pass through warm air through warm air before packing is done.

(e) **Asepsis :** It means avoidence or exclusion of micro organisms. Food material is not brought in contact with microbes. For this some disinfectant like $Ca(OH)_2$ solution are used or a mixture of 85% carbondioxide & 15% ethylene is fumigated.

(f) **Use of chemicals :** Some chemicals like Potasium Metabisulphite and Sodium Benzoate inhibits the growth of micro organisms.

(g) **Steam under pressure :** Use of 'Pressure cooker' is the most effective method of 'high temperature food preservation' since it can kill all vegetative cells and spores.

(ii) **Permanent food preservation :** In this method food inhabiting micro organisms are totally destroyed so that the food can be stored for an indefinite period. Following methods are used for permanent food preservation.

(a) **Dehydration :** When percentage of water is reduced 'Total soluble salt' (T.S.S.) increases and conditions become unfavourable for micro organism to grow. There are two means by which drying of fruits and vegetables can be done by :

- **Sun drying :** Food stuff is kept in sun for several days by spreading it evenly on a tray.
- **Over drying :** Food stuff is first kept in a hot over at 145^{o} *F* for 5 minutes and then taken out and cooled under a fan for 15 minutes. This method is repeated several times.

(b) **Heat sterilization :** Food stuff is first packed in an air tight container and this packed material is subjected to high temperature ($212^{o}F$) in a pressure cooker.

(c) **Osmotic pressure method :** This is based on the principle of plasmolysing and thus arresting the metabolism of a cell. Water is withdrawn from the cells of micro organisms and they get plasmolysed when come in contact with a concentrated solution of sugar, salt, oil.

'Squash' contains, fruit juice (33%) and 55% sugar. 'Jam' which obtained from pulp of fruit and 'Jelly' which is made up of a mixture of fruits juice and pectin contain 66% sugar. In preserving vegetables and fruits as pickles, addition of 18% salt is essential. Sauce (containing 15% solid matter) and ketchup (containing 95% solid matter) also cntain salt, sugar and vinegar as preservatives.

(d) **Use of Vinegar :** Vinegar is chemically acetic acid and makes the medium acidic, reduces pH and checks bacterial growth thus providing food preservation. Used in pickles, sauce, chatni as preservative.

(e) **Antibiotics :** 'Chlorotetracyclin' (CTC) antibiotic is used in poultry and other non-vegetarian products. Besides few antibiotics as terramycin, subtilin and tylosin are also used as food preservatives.

(f) **Radiation :** High energy rays like α, β, γ –rays are used to destroy micro organisms present in food material. Gamma rays and ultraviolet rays have been used more often for this purpose.

(g) **Fermentation :** Food containing carbohydrate is subjected to fermentation as a result of which alcohol and vinegar are produced.

2.3 Origin of agriculture

- After the evolution of man and from the time of his origin, he has been basically a hunter of animals and gatherer of plant products for his food. He lived in small groups, following a nomadic way of life.
- The earliest human civilizations around the river Nile in Egypt, the Chinese river valleys and the northern Indian plains are linked with crop cultivation.
- Evidences indicate that agriculture originated independently in south-east Asia, south west Asia, African and American continents. Food gathering in south west Asia began in 10,000 B.C. whereas food production in 9000 B.C. Then food production spread to eastern Europe and the remaining part of the continent.
- The old stone age or paleolithic period was characterized by the absence of agriculture. Mesolithic period represented a transition period when scanty agriculture began here and there and lasted several thousand years.
- Neolithic or New stone age was fully developed by 3000 B.C. where in agriculture was well developed.
- Carl Saver has pointed out that first plants that grew wild and then cultivated, were nitrogen loving and multipurpose plants.
- The plants cultivated early in the development of agriculture were, hemp *(Cannabis sativa)* and baobab tree (*Adansonia digitate*) in Africa, mulberry tree *(Morus alba)* in china and coconut palm (*Cocos nucifera)* in tropical areas such as Mexico and coastal areas in India.
- In South Africa, the individuals of Kung tribe depend on two plants for their survival. These are mongongo nut *(Reicinidendron rautanenii)* and marama bean *(Bauhinia esculenta)*.
- Another multipurpose plant of tropical areas is coconut palm *(Cocos nucifera)* Which is Knows as "mans most useful tree" and in India it is known as "Kalpa vriksha " or "Tree of heaven".

(1) **Centre of Origin :** Nikolai Ivanovitch Vavilov (1926) proposed different centres of origin for various crop plants on two criteria :

(i) Occurrence of wild relatives (ii) Occurrence of maximum variation in the crop

Out of his 11 centres 10 are given below :

(i) **South East Asia :** Rice, Pigeon pea, Banana, Mango, Orange, Brinjal, Black pepper, Sugarcane.

(ii) **China :** Onion, Tea, Soyabean.

(iii) **South West Asia :** Wheat.

(iv) **Asia minor and Afghanistan :** Rye lentil, Apple, Pear, Apricot, Pomegranate, Pistachio, Almond.

(v) **Mediterranean :** Oat, Lettuce, Cabbage, Beet.

(vi) **Ethiopia :** Barley, Sorghum, Coffee.

(vii) **Brazil :** Groundnut, Pineapple, Rubber.

(viii) **Peruvian Andes (South America) :** Potato, Tomato, Chilli.

(ix) **Mexico and Central America :** Maize and Cotton.

(x) **U.S.A. :** Sunflower.

Important plants of new world are Maize, Potato, Tomato, Sunflower, Groundnut, Red pepper, Pineapple, Guava, Sapota Coco.

- **Natural home :** Place of origin of a cultivated crop.
- **Secondary Home :** The major centre of production of a crop where wild relatives do not occur and which is faraway from the center of origin or natural home.
- **Green Revolution :** It is rapid increase in agricultural out-put as witnessed in India during 1970s. It has been achieved through introduction of high yielding varieties increased irrigation facilities, fertilizer application, weed pest and pathogen control, multiple cropping and better agricultural management .
- **FAO :** Food and Agricultural Organisation of U.N.O.
- **IRRI :** International Rice Research Institute, Los Banos, Philippines.
- **ICRISAT :** International Crops Research Institute for Semi Arid Tropics, Hyderabad, India.

(2) **Additional resources of food in future**

(i) Phytoplanktons (Sea kelps and some red algae) are utilized as food by man.

(ii) A green algae, *Chlorella*, and a fungus *Saccharomyces* (yeast) have protein content 70% and can be potential sources for future protein.

2.4 Plant breeding

The development of new variety of plants possessing desirable characters from the existing ones is called plant Breeding. The crop improvement depends upon favourable environment (Good irrigation, better fertilizers and precautions to avoid losses due to disease) together with superior hereditary characters.

- Swaminathan : Father of plant breeding in India.
- Thomas Fairchild (1717) produced first hybrid plant artificially.
- Cotton Mather (1761) recognised the process of natural selection in maize.
- Joseph Kolreuter (1760-66) produced many hybrids in tobacco.

❑ **Methods of plant breeding**

(1) Plant introduction (2) Selection (3) Hybridization (4) Mutation

(5) Polyploidy (6) Tissue culture (7) Genetic engineering

(1) **Plant introduction**

(i) Plant introduction means introducing a plant having desirable characters (e.g., high yield, disease resistance and vigorous growth) form a region or a country where it grows naturally to region or a country where it did not occur earlier.

(ii) If brought from foreign country, it is called Exotic Collection (EC) but it brought from same country, then it is called Indigenous Collection (IC).

(iii) Introduced plants may be used directly for cultivation (Primary introduction) or may be used after subjecting to selection/ hybridization (Secondary introduction).

(iv) Acclimatisation : The adjustment of newly introduced plant to new or changed environment is called Acclimatisation.

(v) Introduced plant materials are subjected to "plant protection and quarantine regulations" to check the entry of Pathogens.

(vi) New plants are usually introduced in the form of cuttings or seeds.

(vii) Portugese traders and East India Company were foreign agencies which introduced many plants in India.

National Bureau of Plant Genetic Resources, Delhi (Estd., 1976) helps in plant introduction in India.

(2) **Selection** : It is the picking up of plant having desirable characters (e.g., high yield, disease resistant and vigorous growth) from a given pupulation of plants based on its phenotypic characters. This involves preserving of favorable characters and gradual elimination of undesirable ones.

(i) **Methods of selection :** (a) Mass selection (b) Pure line selection (c) Clonal selection

(a) **Mass selection :** It is practised in naturally cross-pollinated crops e.g., Maize. The first step involves selection of plants, having desirable characters from a given population of plants, based on phenotypic characters. The seeds of selected plants are then mixed and sown in the same field (Mixed cropping) to allow natural cross pollination. The plants are selected from this field by eliminating the undesirable ones and saving the best. The seeds of selected plants are multiplied in large numbers and supplied to the farmers.

❑ **Advantage**

- It is the simplest, easiest and quickest method of crop improvement.
- It is only method for improving the wild or local varieties to meet the immediate needs of farmers.

(b) **Pure line selection :** It is practised in natural self - pollinated crops e.g., Wheat.

First step involves selection of few plants each having one or more desirable characters from a genetically mixed population. Each of these selected plant is then selfed through several generation to attain homozygosity for the selected characters. The homozygous plants are then multiplied. A Population of homozygous plants raised from a single homozygous plant is called pure line. The pure lines are now crossed to introduce several desirable characters in to a single synthetic one which is then multiplied and supplied to the farmers for cultivation.

- **Advantage :** In pure line selection the selected plants retain their desirable characters for several years.
- **Disadvantage**

- No new genotype are created by pure line selection.
- It requires 10 - 12 years for raising the desired variety.

(c) **Clonal Selection :** It is practised in vegetatively propagated plants e.g., Sugarcane, Banana, Potato, Onion, Turnip etc.

- **Definition :** Clonal selection is the method of selection of desirable clones from the mixed population of vegetatively propagated crops. All the progenies of a single plant obtained vegetatively are known as clone.
- **Procedure :** The first step is selection of a plant from a population of a crop based on phenotypic characters. The plant is then multiplied vegetatively and supplied to the farmers for cultivation.
- **Advantage**

- Varieties are stable and easy to maintain.
- Hybrid vigour is easily utilized.
- Only methods to improve the clonal crops.

- **Limitations**

- Only applicable to vegetatively propagated crops.
- Creats no new variation.

(3) **Hybridization :** It is the method of producing new crop varieties in which two or more plants of unlike genetical constitution are crossed together. The plants which are crossed together may belong to the same species different species or different genera. According to this relationship between parental plants, the hybridization is divided into following categories :

(i) **Intravarietal hybridization :** The crosses are made between the plants of same variety.

(ii) **Intervarietal hybridization :** The crosses are made between the plants belonging to two different varieties of the same species and is also known as intraspecific hybridization.

(iii) **Interspecific hybridization :** The plants of two different species belonging to the same genus are crossed together. It is also known as intergeneric hybridization.

(iv) **Intergeneric hybridization :** The crosses are made between the plant belonging to two different genera.

(v) **Introgressive hybridization :** In this type of hybridization one species is completely replaced by another in nature.

(a) **Procedure**

❑ **Selection of parents :** The first step in hybridization is to select the plants which are to be used as parents and can supply all the desired important characters which lack in a good standard variety.

❑ **Selfing of parents :** This is the second step consisting in artificial self pollination of parents. It is very essential for eliminating the undesirable characters and obtaining inbreeds.

The selected inbreds, before utilization, are tested for combining ability, both specific and general and the most suitable ones are further utilized in the hybridization technique.

(b) **Hybridization Technique**

❑ The inbreeds are grown under normal and protected conditions in the isolated plots so that they may develop properly and get full shelter against insects, pests, animals, birds and diseases.

❑ They are sown at different dates to secure simultaneous flowering. The males and females to be crossed are marked in such a way that the dehiscence of anthers coincides the stigma receptivity. They are then carried out under the following operations :

- **Emasculation :** "The removal of stamens from female parent before they burst and have shed their pollens".
- **Bagging :** To avoid contamination by unwanted pollen, the female and male flowers are covered with cellophane or parchment or paper bags. This process is called bagging.
- **Crossing :** "The artificial cross - pollination between the genetically unlike plants" and after that the female cross pollinated flower is again bagged.
- **Labelling :** The crossed flowers are properly tagged and labelled.

(c) **Harvesting hybrid seeds and raising F_1 generation :** The bags are removed and the crossed heads of desirable characters are harvested and collected with their attached labels separately in envelopes. After complete drying, they are threshed individually and preserved as such.

In coming season, these seeds are sown separately to raise the F_1 generation. The plants of F_1 generation are progenies of crossed seeds and called hybrids.

(d) **Hybridization Methods :** Handling of F_1 and subsequent generations by different selection methods of hybridization which are different for self and cross-pollinated crops.

❑ **Self pollinated crops** : (i) Pedigree method (ii) Bulk method (iii) Back cross method.

❑ **Cross pollinated crops :** (i) Single cross (AxB) (ii) Three cross (AxB) x C.

❑ **Heterosis or Hybrid vigour :** Heterosis or hybrid vigour is the increased vigour growth yield or function of a hybrid over the parents, resulting from the crossing of genetically unlike organisms. Heterosis word used by scientist Shull. The heterosis normally involves two steps :

- The plants are selected for certain desirable characters and are selfed repeatedly through several generations to get pure lines for different characters.
- The pure lines for different desirable characters are crossed to get the heterotic effect in the hybrids.

(4) **Mutation :** Sudden heritable changes in an organism other than those due to mandelian segregation and recombination is called mutation.

(i) **Procedure of mutation breeding**

(a) **Plant material for irradiation :** The plant can be treated in any form i.e. seeds, seedling, shoots and grafts. Seed-short wave length radiations like UV, X-ray, cosmic rays, ionising radiations like gamma rays emitting from radio-active istopes like cobalt 60 calcium 137, chemicals like nitrous oxide, ethylmethane sulphonate (EMS), carbon tatra sulphide, nitromethyl and nitroethyl urea are some of the sources utilised to induce mutation. Many types of wheat like Sharbati, Sonora and Pusa lerma are amber coloured grain mutants of red varieties like Sonora 64 and Lerma Roja - 64.

(ii) **Limitations of mutations breeding**

(a) Most induced mutation are undesirable. Some of which result in death of the organism.

(b) The rates of mutations are very low and large number of plants are employed to select a certain desirable mutant.

(c) Most mutations are not stable and get reverted.

(d) Since mutations are recessive they are expressed only in recessive homozygous condition otherwise they remain undetected.

(e) In sexually reproducing plants mutations are expressed and inherited only if they occur in gametes.

(5) **Polyploidy :** An organism with the number of sets of chromosomes higher that the diploids are termed polyploids and this process called polyploidy. It is of two types :

(i) **Autopolyploidy :** If polyploidy arises within a species. It is called autopolyploidy.

(ii) **Allopolyploids :** If the number of sets of chromosomes gets increase in a heterozygous (breeding between two different species) this is referreds as allopolyploids.

Polyploidy arises either due to fusing of one egg with two sperm or *vice versa*; or by failure of mitosis in somatic cells where chromosomes have duplicated in S- phase of interphase. Artificially polyploidy can be induced by using colchicine.

- Triploid condition arises by crossing a tetraploid (4n) and a diploid (2n) plant e.g., Sugarbeets, apple, pear, guava, banana, water melon, pea, etc.
- They are more vigorous and they have higher yield.
- Triploids exhibit a large degree of sexual sterility and have therefore to be propagated mostly by vegetative means.
- The polyploids which possess an exact multiple of the haploid set of chromosomes are called "euploids".
- Some polyploids where numerical change in chromosome number of individuals is not the exact multiple of haploid genome, which are called Aneuploids".
- Example : Back cross between hybrids of *Saccharum officinarum* X *S. spontaneum with either S. spontaneum* or *S. officinarum.*

Some major crop species of presumed polyploid origin

S.No.	Common name	Scentific name	Apparent base number	Present diploid number and ploidy level
(1)	Wheat	*Triticum*	$x=7$	2n = 28, tetraploid
	(a) Durum	*T. turgidum*		2n = 28, tetraploid
	(b) Club	*T. aestivum*		2n = 42, hexaploid
(2)	Sugarcane	*Saccharum officinarum* (Poaceae)	$x=10$	2n = 80, octaploid
(3)	Tobacco	*Nicotiana tabacum* (Solanaceae)	$x=12$	2n = 48, tetraploid
(4)	Coffee	*Coffea arabica* (Rubiaceae)	$x=11$	2n = 44, tetraploid
(5)	Cotton	*Gossypium hirsutum* (Malvaceae)	$x=13$	2n = 52, tetraploid
(6)	Potato	*Solanum tuberosum* (Solanaceae)	$x=12$	2n = 48, tetraploid
(7)	Strawberry	*Fragaria ananassa* (Rosaceae)	$x=7$	2n = 56, octaploid

(6) **Tissue culture :** Tissue culture requires separation of cells, tissues or organs of a plant and allowing them to grow in aseptic nutrient media under controlled light and temperature. The cultured parts termed explants, require energy (Usually a carbohydrate like sucrose) and salts (Both macro and micro nutrients) apart from vitamins and the amino acid glycine. When a tissue from an organ is cultured, It grows into undifferentiated tissue called "callus". The callus

can be differentiated in to shoot, root or complete plants by manipulating the concentration of Auxin and cytokinin. The advantages of tissue culture in the improvement of crop plants are :

(i) **Micropropagation :** Production of large number of individuals *in vitro* in a limited space which can be employed for agriculture, horticulture and forestry. e.g., Potato, Bananas, *Begonia*, *Carnation, Chrysanthemum* and *Gerbera*.

(ii) **Somatic embryogenesis :** Somatic cells are cultured in electric shakers to obtain single cell suspension. When the number of cells has increased to a maximum depending upon the amount of medium, the culture is made stationary. Each cell starts differentiating in to an independent embryo showing all the stages of embryo development such as globular heart shaped and torpedo shaped stages. They are called "embryoids". Somatic embryoids can give rise a complete plant having normal root system. Success has been achieved in carrot, celery and alfalfa.

(iii) **Raising of disease free plants :** The virus free clones can be obtained from a virus infected plant by tissue culture since virus is translocated through sieve tubes, the apical meristem of virus infected plant remain free of virus. The shoot apex of such plant can be cultured.

(iv) **Androgenic haploids :** These are haploid plants raised form pollen grains by another culture technique. The first example of androgenic haploid was reported by Guha and Maheshwari (1964) from anther culture of *Datura innoxia*.

(v) **Rescue of hybrid embryos :** The hybrid embryos produced as result of interspecific or intergeneric crosses normally collapse due to incompatibility. These embryos can be isolated from female plants and rescued by growing on synthetic medium.

(vi) **Induction and selection of desirable mutants :** The single cell cultures raised in electric shakers are allowed to grow in static cultures where the cells divide to form colonies. These cells are treated with chemical or physical mutagens to induce mutations. The desirable mutants are selected and multiplied.

(vii) **Somaclonal variations :** The spontaneous variations which appear in cells or tissues in artificial medium are known as somaclonal variations. The variants having desirable traits such as tolerance to pests, pesticides, diseases and environmental stresses are selected and exploited for agricultural purpose.

(viii) **Somatic hybridization :** This involves the fusion of two protoplasts isolated from two different species or genera. The cellulosic cell wall and middle lamella (pectinaceous) are dissolved by making use of the enzyme pectinase and cellulase. The protoplasts can be isolated from leaves, callus from single cell cultures and are then grown on solid medium containing balanced nutrients. e.g., Bromato (cross between brinjal and tomato).

(7) **Genetic engineering :** Genetic engineering aims at adding, removing or repairing a part of the genetic material (DNA). This is achieved by changing the phenotype according to will :

(i) Transformation (ii) Transduction (iii) Plasmids transfer

These are the three processes by which genotype of an individual can be changed artificially.

❑ **Prospects of genetic engineering**

- Genetic engineering has put us in a threshold of a new form of medicine, “gene therapy” to find cures for crippling diseases like haemophilia and phenylketonuria.
- Introduction of genes coding for vitamins, harmones etc., in higher animals opens up new vistas.
- Possibility of transfer of nitrogen fixing genes from bacteria or blue green algae to major food crops is bound to enhance food production.
- Production of new plants and animals tailored to new characteristics is now a reality.
- Through study of the nature and functions of the heredity material is possible because of their technique leading to location of specific genes with in the chromosomes and a deeper insight with in to when and where enzymes are made.

❑ **Methods**

- Isolation of desired genetic material.
- Extraction and purification of DNA.
- DNA multiplied by use of replicating enzymes.
- Transfer of DNA from one organism to another organism.

2.5 Biotechnology

Biotechnology is the utilisation of living organisms (or of substances obtained from them) in industrial processes. The organisms involved in biotechnology range from complex organisms like cattle to simple unicellular yeast.

(1) **Manufacture of cheese :** In old days, cheese was prepared by using the enzyme "rennet" from the lining of stomach of sheep and goat. In 1874 Christian Hansen, a Danish chemist extracted rennet from calf's stomach and used it for commercial production of cheese.

It is made by separating casein and fat of milk form the liquid. About 400 kinds of cheese are known which can be made from many types of milk (goats, cows, buffaloes or camels) by employing microbes under favourable conditions.

(i) **Two types of cheese**

(a) Unripended cheese

(b) Ripened cheese (hard cheese ripened internally and soft cheese ripened from out side).

(ii) **Manufacture of cheese involves the following steps**

(a) Milk is inoculated with a starter culture of bacteria (*Streptocooccus lactis* or *S. cremoris*) and warmed at 38°*C*. If higher temperatures (50°*C* or more) are used, the starter

culture consists of *S. Thermophilus* combined with *Lactobacillus lactis, L. bulgaricus* or *L. helveticus*.

(b) When a certain acidity is reached by the activity of the bacteria, rennet extract obtained from calf stomach is added curdling of milk occurs within one half to half an hour.

(c) The curd is removed and the liquid which separates out is called " whey". Whey contain 93% water, 5% lactose mineral and some other substances and is used for the manufacture of lactic acid if cheese is used at this unripened stage, it is called cottage cheese.

(d) The salt is applied to cottage cheese and it is put in to frames and pressed so as to allow continual removal of whey. Salt hastens the removal of moisture and prevents the growth of undesirable microbes. The frames are removed as soon as the cheese has set sufficiently to maintain its shape.

(e) To produce cheese of a desired flavor, it is ripened by employing different bacteria or fungi at a required low temperature and humidity. The ripening period varies from 1-16 months. Cheese is very nutritious because it contains about 20-30% fat, 20-35% proteins and a small amount of minerals and vitamins. Nearly 400 varities of cheese are available which can be classified in to the categories listed below :

Type of Cheese	Micro organisms used	Reaction
Soft		
(A) Camembert	*Penicillium camemberti, Brevibacterium*	Ripend by action of microorganisms on the surface of curd
(B) Limburger	*Streptococcus liquifaciens, Brevibacterium*	
Semi-hard		
(A) Roquefort	*Penicillium roqueforti*	Combination of surface and interior
(B) Blue		

(2) **Antibiotics :** Antibiotics are substances, primarily produced by certain harmless micro-organisms which in low concentrations are antagonistic to the growth of other micro-organisms such as pathogenic bacteria. The term antibiotic was coined by **Selman Waksman** in 1942. The property of antibiotics to kill pathogenic micro-organisms is called autobiosis. Chemo-therapeutic value of penicillin was first reported by Florey *et.al*. (1939). Antibiotics are of 2 types :

(i) **Broad spectrum antibiotics :** Which have a capacity to destroy several pathogenic species of micro-organisms.

(ii) **Specific antibiotics :** Which have a limited action on a few similar type of pathogens.

❑ **Biosynthesis of somatostatin :** This hormone is secreted from front lobe of pitutary gland. It is made up of 191 amino acid units. Ross isolated first this hormone. The individual

suffers dwarfness due to its deficiency. The gene or DNA of this hormone is introduced in *E. coli*, near the gene which codes for *β*-galactosidase.

❑ **Biosynthesis of insulin :** It is a proteinaceons hormone secreted by β-cells of islets of Langerhans of pancreas. In 1916, sharpy-shafer suggested that diabetics occurs due to failure of some islands of pancreas to secrete insulin. In 1921, Aanting and best isolated insulin from pancreas of a dog and showed its efficiency in curing diabetes in human beings. Later on insulin was extracted from pancreas of slaughtered pigs and cottles. Human insulin is formed of 51 amino acids arranged in two polypeptide chains. In 1983 an American company produced first genetically engineered insulin called humulin with the help of *E. coli*.

(3) **Yeast and Alcohol :** Yeasts (*Saccharomyces cerevisiae*) are single celled fungal organisms. Role of yeast in the production of alcohol, beer, and butter milk was first reported by Louis Pasteur. The process by which the yeasts help in production of alcohol, beer, wine and making of bread, dosa and idli is called fermentation.

(i) **Types of yeasts**

(a) **Baker's yeast :** These include the selected strains of *Saccharomyces cerevisiae* and *Torulopsis utilis*. Grown on molasses. These are used to flavour the food, as nutrient ingredients, to ferment and raise dough in bread making (leavening agent).

(b) **Brewer's yeast :** Brewing industry produces alcoholic beverages of several types depending upon the fermenting agent and the medium. Fermenting agents are *Saccharomyces cerevisiae*, *S. sake, S. ellipsoidens* (wine yeast) and *S. pireformis* (ginger yeast). Molasses is dark coloured syrup left after extraction of sugar. It still contains 30% sucrose and about 32% invert sugar (mixture of glucose and fructose).

(ii) **Industrial production of alcohol :** Living yeast cells are immobilized in calcium alginate beads. The beads with living cells are placed in the nutrient medium in the fermentation tank. CO_2 is a bi-product of alcohol fermentation. It is collected separately. The medium with fermented product contains yeast cells. Yeast cells are isolated. A part of yeast is kept for further inoculation. The remaining part of the yeast is washed, dried and employed as animal feed.

(4) **Vitamins :** Term vitamin was given by **Funk** (1912). Vitamins are organic compounds, generally taken in small amounts along with food and regulate various metabolic activities of body. First vitamin to be isolated was B_1(by Funk). Vitamin C was the first vitamin to be produced during fermentation by Albert Gyorgy. Vitamin A and vitamin D were isolated by Mc. Collum and Mellan, respectively.

(i) **Riboflavin** (Vitamin B_2) **:** Produced in 1938, Fungi (*Ashbya gosypi*) and Yeast (*Eremothecium ashbyii*) are the main source.

(ii) **Cobalamine** (Vitamin B_{12}) **:** Isolated in 1948 from liver extract. It is obtained from the substances rich in cobalt by the action of *Propiobacterium grendenreichii, Bacillus megatherium* and *Streptomyces olivaceous*.

(iii) **Ascorbic acid** (Vitamin C) **:** The precursor of ascorbic acid is L-sorbose which is produced from dehydrogenation of D-sorbitol using *Acetobacter suboxydans*.

(5) **Dextrins :** These are soluble polysaccharides formed by simple sugars through the agency of micro-organisms like *Leuconostoc mesenteroides* or its enzyme called dextran sucrose. Fermentation is allowed to proceed till dextrins are obtained. Dextrans represent the 6-10% solution of dextrins. Dextrans are plasma substitutes and are given during shock, haemorrhage, dehydration, etc.

(6) **Vaccines :** Vaccines contain dead or attenuated (live but weak) pathogens or its antigens. When a vaccine is injected into a healthy person, it provides temporary or permanent immunity to a particular disease. This method of protective inoculation is called vaccination. It was first introduced by **Edward Jenner** (1790). Louis Pasteur (1879) discovered cholera vaccine. Vaccines produced by conventional techniques are called first generation vaccines. Second generation vaccines have been produced by genetic engineering e.g. against hepatitis B-virus that is causative agent of liver cancer and jaundice. Synthesized vaccines are called third generation vaccines. In India, National Institute of Immunology, New Delhi is involved in the production of antifertility vaccines and kits to detect pregnancy and infectious diseases like amoebiasis, leprosy, hepatitis etc.

(7) **Organic acids :** Microbes are useful in the manufacture of a number of organic acids.

(i) **Acetic acid :** It is most important acid being produced by the fermentation of carbohydrates. It is used in phormaceuticals, colouring agents, insecticides and plastics.

(ii) **Lactic acid :** It was the first organic acid to be produced from microbial fermentation of lactose (milk sugar). Fermenting agents are bacteria, e.g, *Streptococcus lactis* and *Lactobacillus* and Fungi, *e.g.*, *Rhizopus*. Lactic acid is used in confectionery, fruit juices, essence, pickles, canned vegetables and fish products.

(iii) **Citric acid :** It is obtained by the fermentation of sugar syrup by *Aspergillus niger* and *Mucor* species. It is used in dyeing, engraving, medicines, flavouring and preservation of food and candies.

(iv) **Gluconic acid :** It is prepared by the activity of *Aspergillus niger* and *Penicillium*. It is used in preparation of pharmaceuticals. It also acts as a source of Ca^{++} in infants cows and lactating mothers.

(8) **Steroids :** Steroids are fatty compounds of high molecular weight which have one 5 carbon and three 6 carbon rings. Biologically important steroids are cholesterol, testosterone, oesterogens, progesterone, cortisterone, cortisone etc. **Murrey** and **Patterson** (1950) reported the role of *Rhizopus stolonifer* to bring about hydroxylation required for steroid synthesis.

Steroids are used to treat individuals with hormonal imbalances. Diosgenin derived from dioscorea has antiinfertility property.

(9) **Enzymes :** Enzymes are proteinaceons substances of biological origin which catalyse specific biochemical reactions without themselves undergoing any change. The term enzyme was coined by **William Kuhne** (1867) from the yeast. **Buchner** (1897) found that living cells of yeast are not required for alcoholic fermentation, but their extract also causes fermentation. In dialysis process, which is used to remove small molecules from enzymes.

(i) **Enzymes obtained by microbial activity**

(a) **Rennet :** In 1874, a Danish chemist **Christian Hansen**, provided the first relatively pure enzyme rennin from calf's stomach.

(b) **Amylase :** These degrade starch. These are obtained from bacteria like *Bacillus subtilis, B. macerans, B. polymyxa* and Fungi like *Aspergillus niger* and *Rhizopus oryzae*.

(c) **Proteases :** It is extracted from *Mortierella renispora* and *Aspergillus*. They degrade proteins and polypeptides.

(d) **Lipase :** Used in making cheese from pasteurized milk obtained from *Candida lipolytica*. Also lactases, penicillase and sucrose are obtained from microbial activity.

(ii) **Role of enzyme in medicine**

(a) **TPA (Tissue plasminogen activator) enzyme :** It is used to dissolved blood clots in people suffering from heart disorders.

(b) **Protein modifying enzymes :** Some enzymes are known to modify proteins for human used e.g., conversion of pig insulin into human insulin and called Pseumcelin.

(10) **Monoclonal antibodies :** The monoclonal antibodies are pure, high affinity, antigen specific proteinaceons bodies developed outside the body from clonal cultures of hybrid cells called "Hybridomas". These were first discovered by **George Kohler** and **Cesar Milstein** (1974). Who proposed that normal antibody producing cells can be used to fuse and inhibit cells from cancerous tumours and called "Myelomas".

(11) **Yoghurt :** For the production of yogurt. Pasteurized milk is inoculated with a mixture of *Steptococcus thermophilis* and *Lactobacillus vulgaricus* and fermented at 40°C. Curdling of milk is done by lactic acid. From this semi-solid curd. Yoghurt is extracted. America produces 75 Lack kg of yoghurt yearly.

Antibiotic produced by micro-organisms

Antibiotic	Microbial source	Action	Discovery
Penicillin	*Penicillin notatum* and *P. chrysogenum*	Inhibits growth of P*neumococcus, Streptococcus, Gonococcus*; cure gonococal infection, rheumatic fever, pneumonias diseases.	Sir Alexander Fleming (1928)
Streptomycin	*Streptomyces griseus*	Active against acid-fast and Gram-negative bacilli, cure pulmonary tuberculosis, may injure 8th cranial or auditory nerve.	Waksman (1943)
Chloramphenic			Ehrlic *et.al.* (1947)

ol	*S. Venezuelae*	Broad spectrum against bacterial and rickettsial infections, viral psittacosis.	Duggar (1947)
Tetracyclines			
Chlorotetracycline (Aureomycin)	*S. aureofaciens*	Broad spectrum against Gram-negative organisms; cure rickettsia and some viral diseases.	
Oxytetracycline (Terramycin)	*S. rimosus*	Broad spectrum against bacteria, rickettsia, spirochetes, some viruses typhoid and amoebiasis; non-toxic.	
Tetracycline (Archromycin)	*S. taxas (soil)*	Resemble the spectrum of chlorotetracycline.	
Dimethyl chlorotetracycline	*S.aureofaciens's mutant*	More effective against bacterial and streptococal infections.	Clerk (1953)
Macrolides			
Erythromycin	*S. erythraeus*	Bacteriostatic to Gram-posotive and some Gram-negative organisms that are resistant to penicillin; non-toxic.	
Carbomycin	*S. halstedii*		
Ravomycin	*S. ambofaciens*		Hazen and Brown (1953)
Antifungal			
Nystatin	*S. noursei*	Used adjunct to tetracyclines.	
Griseofluvin	*Penicillium griseofulvin*	Inhibits growth of most of the fungi but not of bacteria; used in ringworm treatment.	Hindustan Antibiotics, Poona
Hamycin	*S. Pimprei*	Fungal infection like thrush.	Discovered in 1957
Miscellaneous	*S. Orientalis*		Discovered in 1956
Vancomycin (Ristocetin)	*S. Spheroides*	Range of activity is similar to penicillin	
Novobiocin (Cathomycin)	*Bacillus bravis*	Antimicrobial spectrum resembles penicillin.	Dubos (1939)
Tyrothrycin	*S. Polymyxa*	Antibacterial, inhibits Gram-positive becteria and cocci.	Discovered in 1947
Polymyxin A,B,C & D	*Streptomyces fradiae*	Intestinal antiseptic; toxic.	
Neomycin	*S. puniceus*		
Viomycin		Resembles streptomycin; but toxic to kidneys	

Farmycetin Cycloserine Azaserine Actinomycin C & D	*S. decaris* *S. orchidacens* *S. fragilis* *S. chrysomallus*	and ear. Cure leukemia; toxic to glossitis.	Moore *et al* (1954)
Fumagillin	*Aspergillus fumigatus*	Used in the treatment of willm's tumor, embryonic tumor of kidney in children. Bacterial and wide range, spectrum includes *Salmonella* and *Shigella* sps.	

2.6 Bioenergy

The energy obtained from biological sources is called **bioenergy**. Bioenergy is the use of biomass (organic matter) to produce electricity, transportation fuels or chemicals. Bioenergy sources include agriculture and forestry residues and the organic component of municipal and industrial wastes.

Bioenergy is obtained from following types of biological sources :

(1) Animal energy

(2) Biofuels and Biomass

Another category of energy which is of biological origin is called as fossil fuels which includes coal, petroleum and natural gas. Energy is very critical to all developments of human welfare like transport, agriculture and industrial uses.

(1) **Animal energy** : Animal energy is basically of two forms :

(i) Human muscle power (HMP)

(ii) Draught animal power (DAP)

(i) **Human muscle power (HMP) :** It is the form of animal energy, which is used throughout the world in the form of physical work by human race like farmers in the field, women in house work and non agricultural labourers like artisans in wood work, gardeners, etc. A major part of the energy utilized today belongs to this type and it constitutes about $1/5^{th}$ of the total generated electricity in India. Thus, it constitutes the significant part of energy used.

(ii) **Draught animal power (DAP) :** Animals are domesticated not only for providing us with food, hides and bones but they are also used in agriculture and transport. These animals play and important role in villages. India has about 84 million of work animals; 70 million bullocks; 8 million buffaloes and one million each to horses and camels. In addition mules, donkeys, elephants and yaks are also used. 50 percent of the Indian farmers have holdings less than two acres each, as a result they cannot use tractors. More than 15 million animal-drawn carts are use in India. Carts have the advantage that they can be used on all types of roads in all

terrains. The energy potential of DAP is enormous. Suppose if each animal generates 0.5 horse power then the installed capacity of animals comes about 42 million horse power or 30,500 MV. This value is almost equal to total electric power generation in India. Because of poor quality of animals and outmoded designs of carts and agricultural machinery, full potential of DAP has not been realised in India. Methods recommended to achieve this are :

(a) Improved breeds of draught animals.

(b) Use of better carts.

(c) Proper management of grazing lands and pastures.

(d) Supply of nutritious fodder.

(2) **Biofuels and Biomass :** They are fuels of biological origin. Biofuels are major source of energy. They are **renewable** and if used properly and efficiently they can solve the energy problems of developing countries.

Biomass is the term applied to all materials whose origin can be traced to photosynthesis. Biomass can be used to generate producer gas, to run water pumps for irrigation, to obtain alcohol, to replace petrol, to generate biogas for cooking and lighting and to generate electricity.

Major sources of biofuels are :

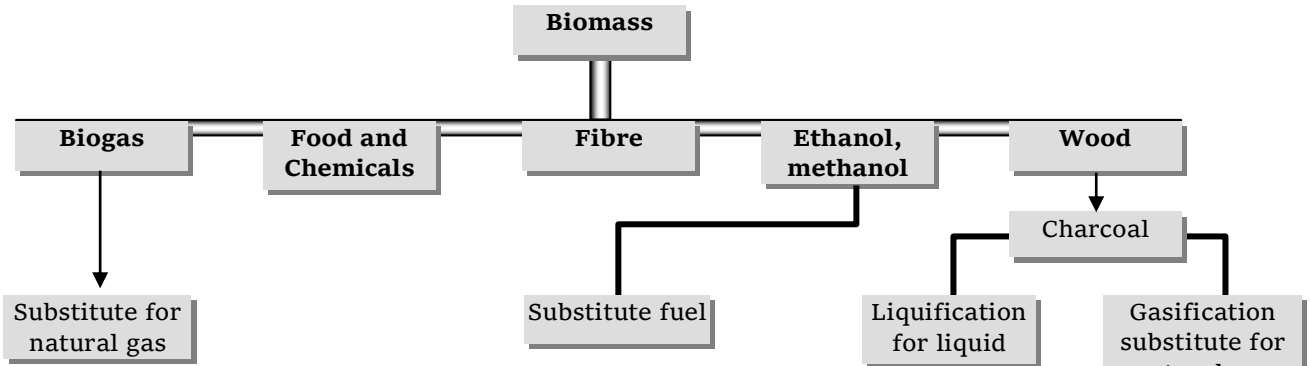
(i) Wood

(ii) Agro-industrial trial residues

(iii) Energy cropping and petroplants

Ways of utilising biomass as fuel

Biomass	Process	Form / Source of energy produced
1. Wood	Direct burning, Gasification, Carbonisation, Pyrolysis, Hydrolysis, Fermentation and Synthesis.	Heat, Producer gas, Methanol, Ethanol, Charcoal gas, Oil and Charcoal.
2. Agro-industrial residues.	Fermentation/Distillation, Anaerobic digestion.	Biogas, Ethanol.
3. Petroleum and Oil producing plants	Cracking and direct use.	Petroleum products, Heating, Running engines.
4. Energy cropping	Fermentation/ Distillations.	Ethanol.



(i) **Wood :** It is the renewable and most common source of energy in use since time immemorial. Wood which is used as source of energy is called fuel wood and about 2 billion people in world are dependent upon wood as source of fuel. Excessive use of wood as fuel has led to deforestation, soil erosion, loss in fertility of soil and hence deterioration of environment.

The consumption of fuel wood was estimated at 1.7 billion m^3 in 1984 of which more than two third was consumed in Asia and Africa.

❑ **Characteristics of good fire wood**

- It should be highly combustible.
- It should have high calorific value and should be free of disagreeable odour.
- The fuel wood plants should be present every where.
- These should be easy to dry and should not split when burnt.
- Should be non-resinous in nature and smokeless.

Good fire woods and bad fire woods

Good fire-woods	Bad fire-woods
Acatica senegal (Gum Arabic)	*Pinus roxburghii* (Chir Pine)
Acacia nilotica (Kikar)	*Mangifera indica* (Mango)
Albizzia (Siris)	*Madhuca indica* (Mahua)
Azadirachta indica (Neem)	*Bauhinia racemosa* (Kachnar)
Quercus (Oak)	*Bombax* (Red silk cotton)
Casurina (Jhau)	*Michelia excelsa* (Champak)
Adina cordifolia (yellow teak)	
Hopea (Dammar tree)	
Dalbergia sisso (Shisham)	
Prosopis (Jand)	
Anogeissus latifolia (Axle wood, Dhawa)	
Ceriops tagal (Goran)	
Gmelina arborea (Gumhar)	
Terminalia tomentosa (Asna)	
Syzgium cumini (Jambolana Jaman)	

The angiospermic wood (hard wood) is generally better than gymnospermic wood (soft wood). Soft wood produces intense heat but for shorter duration and hard wood gives uniform heat for longer periods. Bad fuelwood does not catch fire quickly, has low flame, low calorific value, gets burnt quickly, is full of smoke with offensive odour.

Due to increase in population, the demand of fuel wood is increasing day by day and this has led to fuel wood crises. In order to overcome fuel wood crisis, following methods have been suggested :

- To grow more fuel wood trees, i.e. energy plantations.
- Proper designing of wood stoves or chullahs in order to increase efficiency of these and hence to save energy loss.
- Electric cremation should be enhanced.
- Energy production form woods by different processes like **carbonisation** (Change of wood into carbon/charcoal by heating), **gasification** (change of wood into producer gas by passing steam over incandescent coke), **pyrolysis** (thermochemical conversion of wood into charcoal, pyroligneous acid (10% acetic acid), wood gas, wood tar, wood alcohol, etc.).

❑ **Energy plantations** : Energy plantations mean to grow more trees for fuelwood. The uses of energy plantations are :

- Solar energy can be stored continuously.
- Minimum technology is required for raising the trees.
- They are ecologically safe, economical, renewable and sufficient manpower is available to raise them.

❑ **The key points linked with raising of energy plantations are :**

Mobilisation of land resources : to minimise the danger of loss of agricultural land for growing fuelwood, trees should be grown for fuelwood on :

- Farmer's land
- Village common lands
- Along both sides of road, canals and railway tracks
- On degraded forests and
- On wastelands

Over 30 million hectares of land is available in India for energy plantations, without affecting land under agricultural and industrial use.

Selection of suitable species : While selecting suitable species following criteria can be considered :

- The saplings should establish quickly and rapidly.
- The species should be preferably local and wall adapted local climatic and soil conditions.
- It should have high coppicing ability or regenerative potential. **Coppicing** means thick growth of branches from the stump after the aerial branches have been removed.

- The plant should be able to grow with minimum water and fertilizer requirement.
- The plant should draw minimum quantity of nutrients form soil.
- Plants should be able to improve the soil quality like sterilisation, correction of alkalinity or acidity etc.
- Plants should have the xerophytic character when grown under xeric conditions.
- Plants should be resistant to pests and diseases.
- Plants grown along both the sides of roads and railway tracks should be able to tolerate water logging.

Development of suitable agro-technology : Techniques of growing particular species in particular habitat must be carried out to get maximum yield. Cultivating grasses and fodder crops along with fuel wood species brings out maximum land use.

Producer gas : It is mixture of carbon, hydrogen, monoxide and oxygen. Producer gas is produced due to incomplete combusion of coal and wood. With restricted supply of air, coal and wood is burnt. Mixture gas thus produced is passed through filter to remove shoot and ashes. Now the gas is passed through coolers to condense other waste residue. Now the gas is released for industrial use. This gas is free from pollution. Raw material for producer gas is easily available and can be produced at normal temperature. The gas produced is inflammable but otherwise costly and generates less power.

(ii) **Agro-industrial residues** : Some methods have been devised for bioconversion of agricultural residues, industrial waste materials and animal wastes into energy. This is very important in solving the environmental pollution problems. About 28 percent of population in the developing countries uses dung and crop residues as fuel for cooking food. Thus potential fertilizer of the agricultural fields is wasted in burning. The problem can be solved by using dung to produce gobar gas (biogas) and residue can be used as manure. The aerobic fermentation of dung yields fuel as well as fertilizer.

(a) **Biogas (Gobar gas)** : Biogas is a gas produced from animal wastes and other organic (biological matter). The gas is produced by anaerobic fermentation of biomass. Biogas consists of 50- 70% CH_4 (methane), 30- 40% CO_2, 1% H_2S and traces of H_2, N_2, O_2 and CO. Calorific value of biogas is 4,429 $kcal/m^3$, when its CH_4 content is 50%.

Biogas generation is a three stage anaerobic digestion of animal and other organic wastes.

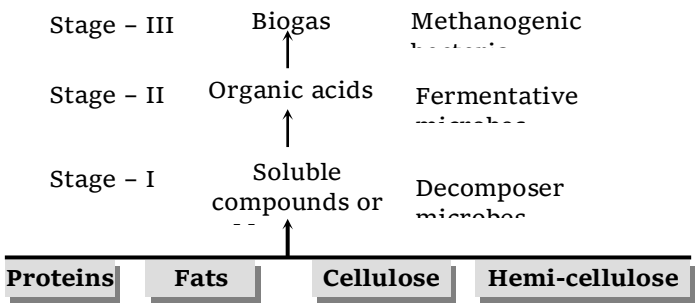


Fig : Possible stages in anaerobic digestion during biogas formation

❑ **First stage** : The facultative anaerobic micro-organisms break down the polymers into soluble monomers with the help of enzymatic hydrolysis. Lignin cannot be broken down by micro-organisms, so it remains as residue along with inorganic salts.

❑ **Second stage** : Here the monomers become the substrate for micro-organisms. These are then converted into organic acids.

❑ **Third stage** : In this stage soluble organic acids (acetic acid) are formed for the substrates of the last stage. Finally methanogenic anaerobic bacteria produce methane (biogas).

- **Important substrates in biogas production :** Animal wastes like dung of cattle, urine and slaughter house wastes; agroindustrial wastes like oil cakes, sugar industry wastes, wastes form fruits and vegetables processing; agricultural or crop residues; human wastes (night soil); urban solid wastes and also aquatic plants like *Eichhorina* (water hyacinth), *Wolffia, Hydrilla, Salvinia, Azolla* and algae, etc.

- In biogas production, water content is maintained at 90% at which most methanogenic bacteria are active.

The biogas so produced can be used for different purposes, can be efficiently used and stored easily. Further pathogens of faecal matter can be reduced (sanitation) and thus disease cycles are broken.

(iii) **Energy cropping and petroplants :** These are renewable resources of energy. Growing of crops from which alcohol and other energy fuels can be produced, constitute energy cropping. Important plants of energy cropping (*i.e.*, energy crops) are :

(a) *Saccharum officinarum* (Sugar cane)

(b) *Beta vulgaris* (Beet root or Chukandar)

(c) *Solanum tuberosum* (Potato)

(d) *Zea mays* (Maize)

(e) *Manihot glaziovii* (Tapioca)

These plants are efficient users of solar energy. These plants can be easily changed into ethanol (ethyl alcohol). In Brazil, ethanol fuel is used in automobiles (95% alcohol), where as in USA, 85-90% petrol is mixed with 10- 15% alcohol to form a new fuel called gasohol, which is used as fuel in automobiles. But slight modification is required in conventional engines to use these new fuels, i.e., ethanol and gasohol.

Petroplants or Petrocrops : Latex of some plants containing long chain hydrocarbons is considered to be a good substitute for liquid fuels or petroleum. Such plants having large

amount of latex with long chain hydrocarbons are called petroplants. Cultivation of petroplants is also a part of energy-cropping. Cultivation of these petrocrops was first of all done by Italians in Ethiopia about fifty years back, although actual credit for identifying the petrocrops goes to Dr. Melvin Calvin.

Dr. Calvin was first to identity few petroleum plants whose products can be used in place of petrol and oil. Most of such plants belong to families asclepiadaceae, euphorbiaceae and apocynaceae. These plants are able to convert a substantial amount of photosynthates into latex.

Latex contains long chained liquid hydrocarbons. These can be used directly or broken to hydrocarbons of chain length similar to the ones present in petrol.

Their hydrocarbon contents can be increased by genetic manipulations (genetic engineering). But commercial production of petroleum or liquid fuel alternative (through petroplants) is in early stage.

Most common petrocrops are :

(a) *Euphorbia antisyphilitica*

(b) *E. caudicifolia*

(c) *E. lathyris* (Gasoline tree)

(d) *E. royleana*

(e) *Calotropis procera*

(f) *Capaifera langsdorfii* (A Brazilian tree and its sap is a good alternative for diesel. About 3 litres of sap per month is produced per tree, which can be filled directly in fuel tank of diesel engine automobile).

(g) *Cryptostegia grandiflora*

(h) *Pittosporum resiniferum* (Petroleum nut)

The use of these petroplants may reduce the pressure on liquid fuel or petroleum.

2.7 New and Underutilized crops

Out of about 3,50,000 known plants at this time, a few i.e., about 100 plants are being used for fulfilling man's daily requirements. Scientists are in search of less known and underutilized crop plants, which can be used for food and other purposes and thus exploitation of traditional plants can be reduced. Such under-utilized and under-exploited plants are known as **new crops**.

Some of these new and underutilized crops are as follows :

(1) **Triticale** : Triticale is the first man made cereal or crop, which has been produced by intergeneric hybridization between common wheat (*Triticum aestivum*) and European rye (Secale cereale) with a view to combine characters of these two parent plants. *Triticale* is hexaploid, *i.e*, $2n = 6x = 42$ (when tetraploid wheat is used) or octaploid, *i.e.*, $2n = 8x = 56$

(when hexaploid wheat is used). *Triticale* is the first new man-made plant to join the rank of cereals which have long evolutionary history. *Triticale* or triticosecale is not suitable for purpose of bread making due to low gluten content, but it is a good forge crop. *Triticale* is grown all over world, mainly in USSR.

(2) **Winged bean** (*Phosphocarpous tetragonolobus*) : This is a herbaceous plant, which has capacity of nitrogen fixation. The tuberous roots, leaves, shoots, pods and seeds are highly nutritious due to rich source of proteins and edible for humans as well as livestock. When green, the pods, leaves and shoots are used as vegetables, unripe seeds may be used as soups and ripe seeds can be roasted. The ripe seeds contain about 34% proteins and 13% oils (similar to soyabean). Further this plant can be used as a green-manure plant, fodder plant and also as a cover crop.

(3) **Jojoba** (*Simmondsia chinensis*) : This is a shrub, which is native of Mexican deserts. It is important drought desert plant, because it can survive under poor soil and low moisture conditions and hence is being grown in deserts. The seeds of this plant contain about 50% liquid wax, which is similar to sperm whale oil (spermaceti). This liquid wax was originally used in cosmetics, but now is also being used in high performance lubricants. So, growing of this plant can reduce the pressure on sperm whales, which are killed for their oil. Further growth of this plant in deserts will provide natural cover and thus enhance the economic status of the people living in these arid areas.

(4) **Guayule** (*Parthenium argentatum*) : It is commonly known as carrot grass or congress grass. This is native of America and nowadays it is most troublesome terrestrial weed in India and is present in almost all states of India. The roots of this plant secret transcinnamic acid, which inhibits the growth of other plants (allelopathy). This is a shrub and can grow on poor desert soils. This plant is nowadays used in obtaining rubber, which is called Guayule rubber, which is similar to para rubber or hevea rubber. The body of this plant contains caotchouc granules, which are ingredient of rubber. The plant contains 12- 20% rubber on dry wt. basis. This plant can be a natural source of rubber in future.

(5) **Leucaena** (*Leucaena leucocephala*) **:** It is commonly called as subabul. This is a fast growing small tree and is native of central America. This plant is nowadays being planted on a large scale under social-forestry. These plants are used as wind breaks, fire breaks, cover plant for deforested tropical regions, leaves as fodder, wood as fuel and in charcoal formation, paper pulp, rayon and timber. It is also used as shade and cover plant in coffee, tea and rubber plantations. Leucaena is a nitrogen fixing plant and leaves are good sources of green manure. It can grow on poor and worn out marginal lands.

(6) **Oil plant :** Some potential oil yielding plants are there, which provide edible and non-edible oils after suitable treatments. Some potential oil plants are as follows :

(i) **Margosa or Neem** : *Azadirachta indica* (fam. Meliaceae). It is native of Burma (Myanmar) and is widely grown tree in India. Seeds are source of margosa or neem oil with bitter taste, used in soap making.

(ii) **Indrayan or colocynth** : *Citrullus colocynthis* (fam. Cucurbitaceae). It is a perennial trailer. Roots are used in curing jaundice and urinary disease. Fruit pulp is used mediacinally as purgative and bacteriocidal. Seeds have oil.

(iii) **Mahua** : *Madhuca indica*, seeds give oil used in soap making and also in cooking purposes.

(iv) **Buffalo or Wild gourd** : *Cucurbita foetidissima*, it can tolerate heat and drought. Its fruit is employed as a soap substitute. The seeds are oily and edible. The underground storage roots of the plant are source of industrial starch.

(v) **Mustard tree or Kharjal** : *Salvadora perisca*, seeds provide oil which is used commercially.

(vi) **Sal** (*Shorea robusta*) : Trunk yields oleoresin, which is source of 'chua oil' on distillation, which is used in perfumes.

(7) **Fooder trees :** Some important fodder threes are :

(i) **Kikar or Babul** (*Acacia nilotica*) **:** Foliage and pods are widely used for feeding goats and sheep in arid regions of India. Leaves and twigs of *A. senegal* provide fodder also.

(ii) **Siris** (*Albizzia lebbeck*) **:** Young foliage contain about 20% protein and are fed to livestock

(iii) **Peepal** (*Ficus religiosa*) **:** The leaves are lopped for elephant and cattle fodder.

(iv) **White mulberry** (*Morus alba*) **:** The leaves which are avidly browsed by goats, cattle and sheep are deliberately lopped for fodder.

(v) **Basna** (*Sesbania grandiflora*) **:** Cattle relish the fleshy, feathery leaves and long pods in the tropical parts of India.

(8) **Non-alcoholic beverages** (Less-known) **:** Generally, non-alcoholic beverages are obtained form coffee, tea and cocoa, but there are other sources of less known beverages plants. Some of them are :

(i) **Catha edulis :** A decoction from its leaves known as khat. Leaves and buds on chewing have stimulating effect.

(ii) **Cola nitida :** A beverage 'cola' is obtained from seeds in Africa.

(iii) **Ilex paraguariensis** (Mate) **:** It is source of Paraguay tea.

(iv) **Paullina wpana** (Yaco) **:** Guarana seeds used an beverage in South America.

Important tips

☞ *Both methyl alcohol (methanol) and ethyl alcohol (ethanol) can be used as fuel and automobile fuel.*

- *Brazil is obtaining alcohol (Gasohol) from sugarcane while USA is getting it from maize.*
- *Methanogens ane rssential for biogas production.*
- *Dicotyledonous woods (called hard woods) are considered better then gymnosperms woods (called softwoods) because these burns for a longer time and provide uniform heat.*
- ***Coppicing** means thick growth of branches form the stump after the aerial branches have been removed.*
- *Only 0.2 percent of the solar energy that reaches earth's surface is converted into biomass.*
- *Animal energy is available in two forms – HMP and DAP.*
- *The energy potential of DAP is enormous.*
- *A major quantity of wood is used as firewood.*
- *Dung is either used a fuel cakes or as fertilizer.*
- *The crops which can be employed for ethanol production are called **energy crops**.*
- *The fuels which are obtained from organic matter are called **biofuels**.*
- *Fuel gas (methane) is obtained by anaerobic fermentation of gobar.*
- *Alianthus excelsa (tree of heaven) is a fast growing timber tree suitable for wind breaks and shelter belts. Young branches are cut to feed goats.*

***

ASSIGNMENT

ECONOMIC BOTANY

MEDICINAL PLANTS

Basic Level

1. Cinnamon is obtained from
(a) Cinnamomum zeylanicum (b) Eugenia caryophyllata
(c) Coriandrum sativum (d) Capsicum annum

2. The drug santonin is obtained from the flowers of
(a) Artemisia cina (b) Aloe vera
(c) Atropa belladona (d) Colchicum automnales

3. Cinchona quinine was first discovered at
(a) Portugal (b) Peru (c) Poland (d) Central Asia

4. Which of the plant yield the drug belladonna
(a) Atropa belladona (b) Papaver somniferum (c) Acacia arabica (d) Phoenix sylvestris

5. Opium or morphine is obtained from latex of unripe fruit of
(a) Papaver somniferum (b) Coffea arabica (c) Thea sinensis (d) Oryza sativa

6. *Quinine* is important in treatment of malaria is extracted from
(a) Bark of *Cinchona* (b) Bark of *Cinnamon* (c) Stem of *Hevea* (d) Leaves of Ocimum

7. *Reserpine* an alkaloid or drug extracted from roots of the following plant which cures the mental disorders and reduces or check the blood pressure **or** A hypertension drug is derived from
(a) Rauwolfia serpentina (b)Ferula asafoetida (c) Atropa belladona (d) Digitalis perpurea

8. Which of the plant yield yellow dye and also used as medicine
(a) *Curcuma domestica* (b) *Butea monosperma* (c) Both (a) and (b) (d) None of the above

9. Children who urenate in sleep are cured by leaves of
(a) Emblica (b) Smilax (c) *Asparagus* (d) None of the above

10. Medicine for curing *impotency* is prepared by
(a) *Asparagus racemosa* (b)*Acacia arabica* (c) Both (a) and (b) (d) None of the above

11. *Toothache* is cured by the use of
(a) Capsicum annum (b) Jatropha gossypifolia (c) Venda parviflora (d) None of the above

12. *Eczema* and *ringworm* can be cured by the oil obtained from wood distillation of
(a) Tectona grandis (b) Adryranthus aspara (c) Euphorbia (d) None of the above

13. Which leaves are used in *diabetes*
(a) Gymnema sylvestre (b) Strychnos (c) Ipoemoea (d) None of the above

14. *Diarrhoea* treatment is given by the use of
(a) Fruit paste of *Shorea robusta* (b) Fruit pulp of *Mengifera indica*
(c) Fruit pulp of guava (d) All the above

15. Gonorrhoea is cured by the use of

(a) Lectuca sativa (b) Calotropis procera (c) Xeromphis spinosa (d) None of the above

16. Polymyxin B can be extracted from

(a) Anabaena cylindrica (b)Chlorella (c) Laminaria (d) None of the above

17. Narcotic and soothing properties of tobacco is due to **or** Harmful alkaloid contained in the leaves of tobacco is

(a) Caffeine (b) Aconite (c) Nicotine (d) Codeine

18. "Central Drug Research Institute" is situated at

(a) Lucknow (b) Madras (c) Bombay (d) Delhi

19. *Strychnine* which is of medicinal importance is essentially

(a) An antibiotic (b) Antimalarial drug

(c) An alkaloid from *Strychnos nuxvomica* (d) Antihypertensive drug

20. Turpentine is obtained from

(a) Pteridophytes (b) Gymnosperms (*Pinus*) wood

(c) Angiosperms wood (d) Angiosperms (Neem) flower

21. Which part of *Aconitum nepallus* is of medicinal value

(a) Root (b) Stem (c) Flower buds (d) Leaves

22. Which is used to make pain relieving durg

(a) Cinchona (b) *Belladona* (c) Both (a) and (b) (d) None of the above

23. Which alkaloids are present in opium

(a) Codeine (b) Morphine (c) Thebaine (d) All of these

24. Some of the familiar example of the family Liliaceae are

(a) *Saraca indica, Allium cepa, Aloe vera* (b) *Allium sativum, Allium cepa, Aloe vera*

(c) *Allium cepa, Aloe vera, Tamarindus indica*

(d) *Tamarindus indica, Allium cepa, Allium sativum*

25. Chemical substances used against plant diseases are termed as

(a) Bactericides (b) Nematicides (c) Fungicides (d) All of these

26. Heroin is obtained from the plant of

(a) Poppy (b) Tobacco (c) Datura (d) *Cannabis sp.*

27. From which part of *Atropa belladona* the drug '*belladona'* is obtained

(a) Leaves (b) Roots

(c) Stems (d) All the parts of the plant

28. Which of the following drug is sedative, stimulant, antispasmodic

(a) *Atropa belladona* (b) *Atropa acuminata*

(c) *Aconitum heterophyllum* (d) None of the above

29. *Withania somnifera* is the botanical name of

(a) Indian madar (b) Ashwagandha (c) Sarpgandha (d) Mulathi

30. Which of the following is given as a decoction in jaundice, paralysis, urinary troubles, menstrual disorders, inflammatory condition of chest etc.
(a) Aconite (b) Celery (c) Indian madar (d) Harjory

31. Metha Jahar which is useful in rheumatism is obtained from
(a) *Aconitum napellus* (b) *Colchicum* (c) *Exogonium* (d) *Lycorice*

32. The alkaloid colchicine is obtained from
(a) Dried corm of *Colchicum* (b) Dried flowers of *Colchicum*
(c) Dried seeds of *Colchicum* (d) All the above

33. Alkaloids emetine and cephaeline are obtained from
(a) *Cephaelis* (b) *Colchicum* (c) *Exogonium* (d) None of the above

34. Which has got the purgative properties
(a) *Colchicum* (b) *Aconitum* (c) *Exogonium* (d) None of the above

35. Which of the following relieves to check thrust and cough
(a) *Podophyllum* (b) *Lycoris* (c) *Cephaelis* (d) None of the above

36. *Cinchona* is a native of
(a) India (b) China (c) Indonesia (d) South America

37. Quinine is obtained from Bark of
(a) *Cinchona calysaya* (b) *C. officinalis* (c) *C. robusta* (d) All the above

38. *Santalum album* is having
(a) Medicinal properties (b) Properties of super quality of timber
(c) Cosmotic property (d) All the above

39. Atropine used at the time of eye testing is obtained from the leaves of
(a) *Belladona* (b) *Cinchona* (c) *Calotropis* (d) None of the above

40. Which one of the following is a medicinal plant
(a) *Jatropha curcas* (b) *Calendula officinalis* (c) *Tagetus petula* (d) *Sesbania aegyptiaca*

41. An important medicine for bronchitis is obtained from
(a) *Adhatoda vasica* (b) *Curcuma longa*
(c) *Hemidesmus indicus* (d) *Rauwolfia serpentina*

42. 'Stramonium' drug is obtained from the plant species of
(a) *Ocimum* (b) *Rauwolfia* (c) *Datura* (d) *Asphodelus*

43. From which part of Ephedra plant, the drug 'ephedrine' is obtained
(a) Root (b) Stem (c) Leaves (d) Flowers

44. The study of the action of drugs is known as
(a) Pharmacognosy (b) Pharmacology
(c) Physiology (d) Pharmaceutical chemistry

45. Which of the following is generally used in chronic diarrhoea, dysentery, bleeding, piles, leucorrhoea etc
(a) Quinine (b) Ephidrine (c) Chir (d) Cattha

46. Botanical name of 'Sukhdarshan' (Poison bulb) is

(a) *Crinum defixum* (b) *Adhatoda vasica* (c) *Aloe barbedensis* (d) *Calotropis procera*

47. Which of the following is a powerful expectorant and antispasmodic

(a) Vasaka (b) Gheekunvar (c) Sukhdarshan (d) Ak

48. 'Jamalgota' belongs to the family

(a) Euphorbiaceae (b) Labiatae (c) Liliaceae (d) Acanthaceae

49. Leaf juice of which plant is given in chronic fever, haemorrhage, dysentery and dyspepsia and also used to check vomiting

(a) Pan (b) Tulsi (c) Ak (d) Arusa

50. Oxytetracyclin is a

(a) Algal product (b) Actinomycetes product

(c) Angiosperm plant product (d) Fungal product

51. Bark and leaves of which of the following plants are used to store the cloths

(a) *Euphorbia hirta* (b) *Euphorbia thymifolia* (c) *Eclipta alba* (d) *Azadirachta indica*

52. Brahmi is an important tonic for

(a) Brain (b) Body (c) General health (d) None of the above

53. Which of the following plant is called stinging nettle

(a) *Verbascum* (b) *Urticaurens* (c) Adhatoda (d) None of the above

54. Which of the following is a gymnospermic medicinal plant

(a) *Thuja occidentalis* (b) *Areca catechu* (c) *Saponaria* (d) None of the above

55. From which of the following family, drug Atropine is obtained which is used for eye trouble

(a) Solanaceae (b) Liliaceae (c) Ranunculaceae (d) Graminae

56. Lathyrism is caused by

(a) Dal (b) Moth dal (c) Khesari dal (d) Glycine

57. To which family *Atropha belladona* belongs

(a) Ranunculaceae (b) Solanaceae (c) Umbelliferae (d) Cucurbitaceae

58. 'Nagkesar' is obtained from the flowers of

(a) *Mesua ferrea* (b) *Crocus sativus* (c) *Viola odorata* (d) *Centella asiatica*

59. Hyoscymine alkaloid is derived from

(a) *Aloe* (b) *Atropa* (c) *Erythro* xylem (d) None of the above

60. Which of the following is used as local anaesthesia

(a) *Aloe* (b) Cocaine (c) *Calotropis latex* (d) None of the above

61. The alkaloid cocaine is obtained from

(a) Flowers (b) Shoot (c) Leaf (d) None of the above

62. Which of the leaves are used as mosquito repellent

(a) Eucalyptus (b) Digitalis (c) Cassia (d) Stramonium

63. The 'truth drug' scopolamine which was used extensively in the World War II, is obtained from
(a) *Eucalyptus* (b) *Digitalis purpurea*
(c) *Datura stramonium* (d) *Papaver somniferum*

64. Opium is a plant belonging to family
(a) Apocyanaceae (b) Euphorbiaceae (c) Papaveraceae (d) None of the above

65. Ergotin is obtained from
(a) *Colletotrichum* (b) *Claviceps* (c) *Penicillium* (d) *Aspergillus*

66. The durg plant *Aconitum napellus* belongs to the family
(a) Ranunculaceae (b) Apocynaceae (c) Papaveraceae (d) Solanaceae

67. From which part of *Cinchona* a drug is obtained
(a) Pericarp (b) Endosperm (c) Leaf (d) Bark

68. LSD is obtained from
(a) *Rauwolfia* (b) *Cinchona* (c) *Cannabis* (d) *Claviceps*

69. Drugs which induce dreamy state of consciousness is
(a) Sedative (b) Stimulant (c) Depressant (d) Hallucinogen

70. *Rauwolfia serpentina* is termed as a snake root plant because
(a) It possesses venomous poison (b) It smell like a snake
(c) It is used in snake bite (d) Its roots appear snake like

71. Which of the following plant yield the medicine used for pupil dilation
(a) *Allium sepa* (b) *Colchicine* (c) *Atropa* (d) *Rauwolfia*

72. Jalap is obtained from
(a) *Exogonium purga* (b) *Allium sativum* (c) *Glycirrhiza* (d) None of the above

73. Codeine is an alkaloid obtained from
(a) *Papaver somniferum* (b)*Emblica officinalis* (c) *Carum copticum* (d) None of the above

74. Which of the following may be used in mental weakness
(a) Linseed oil (b) Mustard oil (c) Almond oil (d) Til oil

75. *Digitalis purpurea* produces
(a) Toxin (b) Digitoxin (c) Both (a) and (b) (d) None of the above

76. *Aloe barbedensis* belongs to family
(a) Liliaceae (b) Apocyanaceae (c) Graminae (d) None of the above

77. *Salvia officinalis* which used in lung T.B. belongs to family
(a) Labiatae (b) Acanthaceae (c) Euphorbiaceae (d) Apocyanaceae

78. *Sundew* which is a medicinal plant belongs to genus
(a) *Dionia* (b) *Drosera* (c) *Dryopteris* (d) *Drymis*

79. Alkaloid barberine is obtained from roots of
(a) *Bambusa* (b) *Barberris aristata* (c) *Brassica* (d) None of the above

80. The plant which has also been known in India as 'Pagal ki dava'
(a) Sarpgandha (b) Mulathi (c) Indrayan (d) Harjori

81. Study of drug plants is known as
(a) Pharmacy (b) Pharmacology
(c) Pharmacognosy (d) Pharmaceutical chemistry

82. Licorice which is chewed to relieve cough is obtained from

(a) Root (b) Stem (c) Leaf (d) Bark

83. Botanical name of *Liquorice* is

(a) Glycyrrhiza glabra (b) Cissampelos pareira (c) Apium graveolens (d) None of the above

84. Match the following

A	**B**
1. Ranunculaceae	I. Heeng
2. Umbelliferae	II. Indian madar
3. Solanaceae	III. Sarpgandha
4. Menispermaceae	IV. Mulathi
5. Papilionaceae	V. Harjori
6. Apocyanaceae	VI. Ashwagandha
7. Rubiaceae	VII. Ajmod
8. Umbelliferae	VIII. Aconite

Correct pair is

	1	2	3	4	5	6	7	8
(a)	VIII	VII	VI	V	IV	III	II	I
(b)	I	II	III	IV	V	VI	VII	VIII
(c)	II	III	IV	V	VI	VII	VIII	I
(d)	VII	VI	V	IV	III	II	I	VIII

85. Which of the following is given in disorders of the nervous system

(a) Garlic (b) Onion (c) Turmeric (d) Ginger

86. *Cinnamomum zeylanicum* is the botanical name of

(a) Hijjal (b) Dalchini (c) Rohan (d) Kunain

87. Which of the following plant's decoction is given in uterine disorders especially in *menorrhagia* and *leucorrhoea*

(a) Saraca indica (b) Symplocos racemosa

(c) Barringtonia acutangula (d) Soyamida febrifuga

88. The formula of quinine is

(a) $C_{20}H_{23}O_2H_2$ (b) $C_{19}H_{22}N_2O$ (c) $C_{19}H_{22}O_2H_2$ (d) $C_{19}H_{24}O_2N_2$

89. The correct representation of the alkaloids obtained from Opium is

(a) Morphine > Codeine > Thebaine (b) Morphine < Codeine < Thebaine

(c) Morphine > Codeine > Thebaine (d) Morphine < Codeine > Nicotine

90. Opium (Poppy) is cultivated most extensively in

(a) Himalayas (b) Uttar Pradesh (c) Madhya Pradesh (d) Andhra Pradesh

91. *Rauwolfia serpentina* belongs to family

(a) Rubiaceae (b) Solanaceae (c) Malvaceae (d) Apocynaceae

92. Reserpine is used in

(a) Maleria (b) High blood pressure (c) Asthma (d) Spices

93. *Rauwolfia serpentina* which belongs to apocyanaceae yield medicine of

(a) Blood pressure (b) Nervousness (c) Insomnia (d) All the above

94. Ashwagandha belongs to genus
(a) *Solanum* (b) *Withania* (c) *Lycopersicum* (d) None of the above

95. Holy basil (Tulsi) is a member of family
(a) Labiatae (b) Asclepiadaceae (c) Umbelliferae (d) None of the above

96. *Tylophora asthmatica* is useful for
(a) Asthama (b) T.B. (c) Common cold (d) None of the above

97. Which of the following is a blood purifier
(a) *Opium* (b) *Emblica* (c) *Aegale* (d) All the above

98. *Nux vomica* tree belongs to genus
(a) *Emblica* (b) *Ferula* (c) *Strychnos* (d) None of the above

99. Trigonella foenum graecum belongs to family
(a) Solanaceae (b) Apocyanaceae (c) Papilionaceae (d) None of the above

100. Solanum nigrum fruit is used
(a) Diuretic (b) Sedative (c) Expectorant (d) All the above

101. Quinine is chiefly used in
(a) Cosmetic industry (b) Rubber industry (c) Medicinal field (d) Protection of silk

102. Cinchona plant is also known as
(a) Prickly bark (b) Turmeric bark (c) Peruvian bark (d) Devil's dung bark

103. (A)Reserpine (B)Ephedrine
(C)Ajmaline (D)Colchicine
Alkaloid pair which is completely unrelated with Rauwolfia is
(a) A, B (b) B, C (c) C, D (d) B, D

104. Usually morphine is used in the manufacture of
(a) Codein sulphate (b) Opium
(c) Morphine sulphate and hydrochloride (d) Cosmetics

105. Ganja and LSD are classified in
(a) Narcotic (b) Hallucinogens (c) Stimulants (d) Depressent

106. Roots of this species contain valuable alkaloids useful in medicine
(a) Rauwolfia serpentina (b)Emblica officinalis
(c) Azadirachta indica (d) Helianthus annus

107. Which of the following is Indian medicinal plant
(a) Oryza sativa (b) Solenum melongina
(c) Rauvolfia serpentina (d) Saccharum officinarum

108. Which of the following is medicinal plant
(a) *Dalbergia* (b) *Linum* (c) *Aconitum* (d) *Tectona*

109. A drug used in gastritis is
(a) Agar (b) Ergot (c) Aconite (d) All the above

110. Isabgol is obtained from

(a) Root of *Margosa* (b) Fruit skin of *Aegle* (c) Seeds of *Plantago* (d) Bark of *Ocimum*

111. *Kalmegh* (*Andrographis paniculat*) used as a drug to cure

(a) Bronchitis (b) Dyspepsia (c) Both (a) and (b) (d) None of the above

112. Heroin is obtained from the plant of it family

(a) Leguminosae (b) Papaveraceae (c) Liliaceae (d) Solanaceae

113. Which of the following is general homeopathic medicine and given in general debility, chronic rheumatism, intermittent fevers, diarrhoea, hysteria, hydrophobia, cholera etc

(a) *Nux vomica* (b) *Belleric myrobalan* (c) *Emblic* (d) *Blonde psyllium*

114. The medicinally most important part of *Rauwolfia serpentina* is

(a) Root (b) Rhizome (c) Aerial stem (d) All of these

115. Bhang, Ganja and Hashish (Charas) are obtained from

(a) *Rauwolfia* (b) *Calotropis* (c) *Cannabis* (d) *Withania*

116. Garlic powder is extensively used as

(a) Gastric stimulant (b) Carminative (c) Both (a) and (b) (d) None of the above

117. Colchicine is used as a drug to cure

(a) Stomach pain (b) Tooth pain (c) Joint pain (d) None of the above

118. *Mentha piperita* belongs to family

(a) Labiteae (b) Umbelliferae (c) Anacardiaceae (d) Meliaceae

119. Which has narcotic property

(a) Charas (b) Bhang (c) Ganja (d) All the above

120. The drug 'artimisinin' is obtained from

(a) Tuberous roots (b) Flower or floral buds (c) Bark (d) Leaves

FIBRE

Basic Level

121. Which fibre crop occupies the maximum area in India **or** the most cultivated fibre crop in India is

(a) Jute (b) Cotton (c) Flax (d) Sisal

122. Which of the following drup fruit produces oily endosperm

(a) Mango (b) *Cocos nucifera* (c) Both (a) and (b) (d) None of the above

123. Munj is prepared from the leaf of

(a) *Saccharum munja* (b) *Saccharum officinarum* (c)Both (a) and (b) (d) None of the above

124. Jute is obtained from a plant which belongs to family

(a) Tiliaceae (b) Sterculiaceae (c) Malvaceae (d) Euphorbiaceae

125. Sunn hemp fibre is obtained from **or** One of the following is a fibre yielding plant, which one is it

(a) Crotolaria juncea (b) Cicer arietinum (c) Triticum vulgare (d) Impatiens balsamina

126. Fibres are obtained from

(a) Xylem, phloem and sclerenchyma (b)Xylem, parenchyma and epidermis

(c) Xylem, parenchyma and endodermis (d)Xylem, phloem, epidermis and sclerenchyma

127. Hemp fibres are obtained from

(a) Corchorus (b) Cannabis sativa (c) Linum (d) Hibiscus

128. A cultivated plant whose seed epidermis produces abundant cellulosic hairs used in textile industry and manufacture of fine quality paper is

(a) *Cannabis sativa* (b) *Linum usitatissimum*

(c) *Gossypium herbaceum* (d) *Salmalia malabarica*

129. Largest newspaper industry is situated at

(a) Mysore (b) Lucknow (c) Nepanagar (d) Delhi

130. Husk fibres obtained from dry coconut are called **or** One of the following is obtained from fruit wall

(a) Copra (b) Coir (c) Flax (d) Hemp

131. Which state of India is the largest producer of jute

(a) Andhra Pradesh (b) West Bengal (c) Madhya Pradesh (d) Kerala

132. Bamboo grows in

(a) Temperate evergreen forests (b) Tropical rain forests

(c) Deciduous forests (d) Dry deciduous forests

133. Which of the following is not a plant fibre

(a) Flax (b) Coir (c) Silk (d) Hemp

134. From which part of the cotton plant (*Gossypium*), maximum cellulose fibre can be obtained

(a) Root hair (b) Seed hair (c) Stem surface (d) Leaf surface

135. Cotton belongs to the family

(a) Solanaceae (b) Leguminosae (c) Cucurbitaceae (d) Malvaceae

136. The fibre of sunn hemp is obtained from

(a) Leaf (b) Mesocarp (c) Phloem (d) Testa

137. Cotton is a

(a) Surface fibre (b) Hard fibre (c) Bast fibre (d) Stem fibre

138. Jute is obtained from

(a) Leaves of *Linum* sp.

(b) Secondary phloem of stem *Chorchorus* sp.

(c) Secondary phloem of stem *Linum* sp.

(d) Leaves of *Chorchorus* sp.

139. Match the following

Name of the plant	**Family**
1. Cotton	I. Tiliaceae
2. Sisal hemp	II. Malvaceae
3. Patua	III. Agavaceae
4. Munj	IV. Graminae
5. Jute	

Correct pair is

	1	2	3	4	5
(a)	II	III	II	IV	I
(b)	II	I	III	III	IV
(c)	I	II	III	IV	IV
(d)	IV	III	II	II	I

140. Important plant part 'leaf bases' is of

(a) Manila hemp (b) Madras hemp (c) Sun hemp (d) Kankura

141. Matunga, Bombay has one of the following institutes

(a) Industrial Toxicology Research Laboratory (b) Cotton Technology Research Laboratory

(c) National Institute of Oceanography (d) Lloyd Botanical Garden

142. Lint and Fuzz are characteristics of the fibres of

(a) Flax (b) Jute (c) Cotton (d) Coir

143. The fibres associated with phloem are known as

(a) Hard fibre (b) Wood fibre (c) Bast fibre (d) Surface fibre

144. Long fibres of cotton seed are known as

(a) Coir (b) Fuzz (c) Lint (d) Flax

145. What is the genomic constitution of old world varieties of cotton (*Gossypium arboreum, G. herbaceum*) and new world varieties (*G. hirsutum, G. barbedens*)

(a) All diploids (b) All triploids

(c) Old world 3*n* and new world 2*n* (d) Old world 2*n* and new world 4*n*

146. Linen and cambric cloth is made from

(a) Cotton fibre (b) Flax fibre (c) Jute fibre (d) Sunn hemp

147. Patsan is a common cordage fibre. It is obtained from the stem of

(a) *Cannavis sativa* (b) *Hibiscus cannabinus* (c) *Musa textilis* (d) *Agave sisliana*

148. Rayon (Artificial silk) is a viscose yarn. It is made from

(a) Polyethylene (b) Polyester

(c) Wood pulp and cellulose linters (d) Petroleum products

149. The largest fibre crop of east India is

(a) Jute (b) Flax (c) Cotton (d) Coir

150. *Jute Agricultural Research Institute* (JARI) is situated at

(a) Lucknow (U.P.) (b) Barrackpore (West Bengal)

(c) Shillong (Assam) (d) Dhaka (Bangladesh)

151. Cotton fibres are derived from

(a) Pericarp (b) Phloem (c) Pericycle (d) Testa

152. Which of the following families yield fibres

(a) Cruciferae and Leguminoseae (b) Malvaceae and Leguminoseae

(c) Cruciferae and Malvaceae (d) Mimosoideae and Cesalpinoideae

153. An important fibre yielding plant is

(a) *Corchorus* (b) *Cedrus* (c) *Frageria* (d) *Bambusa*

154. Highest quantity of cellulose is found in

(a) Cotton (b) Coir (c) Hemp (d) Flax

155. New world cotton is

(a) Indian cotton (b) American cotton (c) Both (a) and (b) (d) None of the above

156. *Gossypium barbedens* is called

(a) Peru cotton (b) Indian cotton (c) American cotton (d) None of the above

157. Which of the following cotton is suitable for hosiery products

(a) Sea island cotton (b) Egyptian cotton

(c) American cotton (d) All are equally important

158. Which of the processes are involved in cotton industry

(a) Ginning (b) Picking (c) Laping (d) All the above

159. Pericycle of which of the plant contains fibre

(a) Cotton (b) Flax (c) *Cocos nucifera* (d) All the above

160. Which of the process is used to extract fibre from flax and jute

(a) Ginning (b) Laping (c) Retting (d) None of the above

161. Fish net is prepared from

(a) *Gossypium* (b) *Corchorus* (c) *Linum usitattissimum* (d) None of the above

162. Which of the following families have fibre producing plants

(a) Gramineae (b) Malvaceae (c) Linaceae (d) All the above

163. Which families have fibre plants

(a) Bombacaceae (b) Moraceae (c) Tiliaceae (d) All the above

164. What types of fibres are found in plants

(a) Bast fibre (b) Wood fibre

(c) Sclerenchyma of pericycle (d) All the above

165. Which family contain fibre yielding plants

(a) Urticaceae (b) Leguminoceae (c) Amaryllidaceae (d) All the above

166. Which of the fibres have high tensile strength

(a) Textile fibres (b) Filling fibres (c) Natural fibres (d) None of the above

167. Which of the following occupy the first position in cotton production

(a) America (b) China (c) England (d) Africa

168. Which one of the following is a source of textile fibre

(a) *Crotolaria juncea* (b) *Gossypium herbaceum*

(c)*Hibiscus cannabinus* (d) *Cassia occidentalis*

169. In which state the coir industry is concentrated

(a) Maharashtra (b) Tamil Nadu (c) Karnataka (d) Kerala

170. Cultivated cotton is obtained from

(a) Two species (b) Three species (c) Four species (d) One species

171. The botanical name of jute is

(a) *Linum usitatissimum* (b) *Corchorus capsularis*

(c) *Hibiscus sabdariffa* (d) *Crotalaria juncea*

172. Wicker work fibre is obtained from

(a) Cotton (b) *Linum* (c) *Bambusa* (d) All the above

173. Red silk cotton is obtained from

(a) *Salmelia melebarica* (b) *Cochlo spermum* (c) *Calotropis gigantia* (d) *Calotropis procera*

174. *Tapa cloth* is obtained from the member of family

(a) Asclepiadaceae (b) Moraceae (c) Graminae (d) None of the above

175. Which of the fibre is obtained for paper making

(a) *Pinus sp.* (b) *Populus sp.* (c) *Fagus sp.* (d) All the above

176. Ramie fibre is obtained from the member of family

(a) Cruciferae (b) Leguminoceae (c) Urticaceae (d) None of the above

177. Manila hemp is obtained from

(a) Musaceae (b) Liliaceae (c) Amaryllidaceae (d) Malvaceae

178. Agave fibre is obtained from,

(a) *A. cantala* (b) *A. sisalana* (c) *A. funkiana* (d) All the above

179. New Zealand hemp (*Phormium tenax*) is obtained from member of

(a) Liliaceae (b) Solanaceae (c) Agavaceae (d) None of the above

180. Bowstring hemp is obtained from

(a) *Phormium* (b) *Senseviera* (c) *Cocos nucifera* (d) *Areca*

181. Coir fibre is used for preparing

(a) Mats (b) Brush (c) Both (a) and (b) (d) None of the above

182. Brazilian piassava is obtained from

(a) *Attalia funifera* (b) *Borassus* (c) *Caryota urens* (d) All the above

183. Fibrous cells are

(a) Living (**b)** Dead

(c) In some plants they are living (d) None of the above

184. Which of the following is incorrect about sisal hemp

(a) Agavaceae (b) Bast fibres of leaves (c) Ropes and twine (d) Soft fibre

185. The coir industry in India is concentrated in
(a) Karnataka (b) Andhra Pradesh (c) Maharashtra (d) Kerala

186. The botanical name of manila hemp is
(a) *Cannabis sativa* (b) *Hibiscus cannabinus* (c) *Musa taxtilis* (d) Agave sisalana

187. Fibre of great commercial importance derived from the epidermis is
(a) Flax (b) Cotton (c) Hemp (d) Coir

188. The source of cotton is
(a) *Calotropis procera* (b) *Gossypium herbaceum* (c)*Cannabis sativa* (d) *Crotolera juncea*

189. Fibre yielding plant is
(a) *Cannabis sativa* (b) *Cicer arietinum* (c) *Triticum vulgare* (d) None of the above

190. Botanical name of cotton is
(a) *Brassica* (b) *Gossypium* (c) *Hibiscus* (d) *Iberis*

191. Epidermal hairs of the seed coat are the important commodity in
(a) Coconut (b) Jute (c) Banana (d) Cotton

192. Which of the following fibre is a pure cellulose
(a) Cotton fibre (b) Flax fibre (c) Sunn hemp (d) All the above

193. Which of the following crop is most important for human
(a) Barley (b) Wheat (c) Cotton (d) Millet

194. Jute is mainly made up of
(a) Pectin (b) Lignin (c) Suberin (d) Cutin

195. Which of the following is grown as most important source of textile fibres in Bengal
(a) *Crotolaria* (b) *Gossypium* (c) *Corchorus* (d) *Linum*

196. Which of the raw material is used in paper industry
(a) *Agave* (b) *Ficus* (c) *Bambusa* (d) *Corchorus*

197. A fibre of greatest commercial importance is derived from epidermis of seeds or outside the seed coat is
(a) Flax (b) Coir (c) Cotton (d) Hemp

198. Which state in India is the largest producer of cotton
(a) Uttar Pradesh (b) Punjab (c) Rajasthan (**d)** Gujrat

199. One of the group of fibre yielding plants of economic importance is
(a) *Gossypium, Hibiscus, Crotolaria, Cannabis* (b) *Gossypium, Cassia, Lycopersicum*
(c) *Gossypium, Brassica, Glycine* (d) *Gossypium, Agave, Nicotiana*

200. The fibres of commercial importance are obtained from
(a) Parenchyma (b) Collenchyma (c) Chlorenchyma (d) Sclerenchyma

201. Which plant yield several utilizable products including fibre oil and animal food
(a) Sun hemp (b) Jute (c) Cotton (d) Sunflower

202. Cotton fibres are made up of
(a) Protein (b) Fats (c) Polysaccharides (d) None of the above

203. The surface fibres of commercial use are obtained from
(a) *Agave* (**b)** *Gossypium* (c) *Helianthus* (d) *Solanum*

204. Husk fibre coir of commerce come from which part of coconut (*Cocos nucifera*)
(a) Epicarp (b) Mesocarp (c) Endocarp (d) Seed coat

205. An example of monocot fibre yielding plant in
(a) *Corchorus* (b) *Cocos nucifera* (c) *Cotton* (d) *Crotolaria*

206. Which of the product is having epidermal origin
(a) Saffron (b) Cotton fibre (c) Clove (d) Jute

207. The morphology of flax fibre is
(a) Secondary xylen (b) Secondary phloem (c) Pericycle (d) Bark

208. Bast fibres are obtained from
(a) *Corchorus* (Jute) (b) *Gossypium* (Cotton) (c) *Cocos* (Coconut) (d) *Agave*

209. '*Commercial jute*' is morphologically
(a) Phloem (b) Xylem (c) Bast fibre (d) Xylem fibres

210. Sunn hemp (Indian hemp) is derived from
(a) Malvaceae (b) Leguminosae (c) Compositae (d) Solanaceae

211. The flax fibre, the bast fibre or phloem fibres are obtained from
(a) *Cannabis sativa* (b) *Crotolaria juncea* (c) *Cocos nucifera* (d) *Linum usitatissimum*

212. Whose fruits are narcotic in nature
(a) *Jatropha* (b) *Opium* (c) Both (a) and (b) (d) None of the above

213. 'Patua' of *Hibiscus sabdarifa* is
(a) Secondary phloem (b) Collenchymatous hypodermis
(c) Pericycle (d) Epidermis

CERALS , PULSES AND NUTS

Basic Level

214. Which of the following is used as a source of protein **or** Major source of protein is
(a) *Cicer arietinum* (b) *Beta vulgaris*
(c) *Rizobium leguminosarum* (d) *Oryza sativa*

215. Which of the following satisfies the basic requirement of carbohydrate, protein, fat and vitamin in human diet to a greater extent
(a) Wheat (b) Gram (c) Pea nut (d) Soyabean

216. Seeds of *Arachis hypogea* are rich in
(a) Protein and nicotinic acid (b) Fats and lecithin
(c) Vitamin B_1, B_2, B_6 and E (d) All the above

217. *Jaya* and *Padma* are varieties of
(a) Rice (b) Wheat (c) Cotton (d) Chilly

218. Which of the following is a *Rabi* cereal

(a) Bajra (b) Jawar (c) Wheat (d) All the above

219. Important plant part is small sized grain in

(a) *Sorghum vulgare* (b) *Avena sativa* (c) *Hordeum vulgare* (d) *Zea mays*

220. The main source of food and fooder is

(a) Lichen (b) Cereals (c) Fungus (d) Cotton

221. Which of the following may cause abortion in cattles

(a) Wheat seeds infected with rust (b) Wheat seeds infected with smut

(c) Bajra seeds infected with ergot (d) None of the above

222. Which of the family of 'Arhar'

(a) Malvaceae (b) Liliaceae (c) Papilionaceae (d) Solanaceae

223. Which of the following is kidneybean

(a) *Phaseolus vulgaris* (b) *Cicer arietinum* (c) *Cajanus cajan* (d) None of the above

224. *Phaseolus acountifolius* is a

(a) Matbean (b) Kidneybean (c) Soyabean (d) None of the above

225. Which of the following seed is of highest nutritional value

(a) Seed of almond (b) Seed of *Cucurbita* (c) Seed of *Daucus carota* (d)None of the above

226. *Triticum spelta* is cultivated in

(a) USA and Spain (b) India and Russia

(c) All over the world (d) Nowhere in the world

227. Which of the following countries is exporter of wheat

(a) Canada (b) India (c) Australia (d) All the above

228. Wheat straw is a good

(a) Cattle feed (b) As filling fibre (c) Both (a) and (b) (d) None of the above

229. Maize is a

(a) Kharif crop (b) Rabi crop

(c) Cultivated throughout the year (d) None of the above

230. For developing resistant variety of wheat in India, how many maxican dwarf varieties were brought in 1965

(a) 2 (b) 1 (c) 4 (d) 3

231. Kalayan Sona variety of wheat has

(a) Dwarfness (b) Disease resistance (c) Both (a) and (b) (d) None of the above

232. PV_{18} wheat variety has which qualities

(a) Red grains (b) Less protein contents

(c) Grains are less nutritive (d) All the above characters

233. Wheat variety Chhoti lerma was developed in

(a) Pantnagar (U.P.) (b) IARI, New Delhi (c) Ludhiana (d) None of the above

234. Modern cereal Triticale is developed by crossing between
(a) *Triticum* and *Sorghum* (b)*Triticum* and *Avena*
(c)*Triticum* and *Oryza* (d)*Triticum* and *Secale*

235. Which of the following important rice varieties are cultivated in plains of Punjab area
(a) Basmati 370 (b) J.K.W. 277 (c) Zona 349 (d) All the above

236. Which of the following has high sugar contents
(a) Flint corn (b) Dent corn (c) Sweet corn (d) Waxy corn

237. *Oryza sativa* (rice) belongs to
(a) Solanaceae (b) Malvaceae (c) Liliaceae (d) Poaceae

238. Which of the following is called 'Dhaan ka Katora'
(a) Gwalior (b) Indore (c) Chhattisgarh (d) Rewa

239. Rice bran is used to obtain
(a) Oil (b) Protein (c) Starch (d) None of the above

240. Rice suffers from which of the disease
(a) Bacterial wilt (b) False smut (c) Neck rot (d) All the above

241. During fields, the wheat may suffer from
(a) Loose smut (b) Flag smut (c) Stem rust (d) All the above

242. Which of the following is the most important rice growing area
(a) America (b) Europe (c) China (d) All are equally good

243. *Avena sativa* is used as a
(a) Cattle feed (b) Birds meal (c) Meals for the fishes (d) None of the above

244. Which is most important cereal crop of temperate region
(a) Paddy (b) Wheat (c) Maize (d) Barley

245. Richest source of carbohydrates is
(a) Malze (b) Wheat (c) Barley (d) Rice

246. Rice Research Institute is situated at
(a) Coimbatore (b) Cuttuck (c) Shimla (d) Trivendrum

247. Which of the following is a suitable millet
(a) Wheat (b) Bajra (c) Rice (d) All the above

248. Which of the following is millet
(a) *Panicum* (b) *Paspalum* (c) Setaria (d) All the above

249. Chick pea is a good source of
(a) Protein (b) Fat (c) Starch (d) None of the above

250. *Pisum sativum* is a
(a) Pulse (b) Vegetable
(c) Fruit (d) May come under any category depending on stage of development

251. Arhar belongs to genus
(a) *Phaseolus* (b) *Cajanus* (c) *Cicer* (d) All the above

252. Which type of wheat is grown in north India and south India respectively
(a) *T. aestivum* and *T. dicoccum* (b) *T. dicoccum* and *T. aestivum*
(c) *T. Spelta* and *T. durum* (d) *T. compactum* and *T. spelta*

253. Norin gene of dwarfness in wheat is originated by spontaneous mutation in
(a) India (b) Japan (c) USA (d) Mexico

254. Improved Indian variety carrying double genes of dwarfness and higher percentage of protein and lysine is
(a) Sonalika (b) Lerma safed (c) Kalyan (d) Sharbati sonara

255. Which is Indian dwarf wheat
(a) *T. aestivum* (b) *T. turgidum* (c) *T. sphaerococcum* (d) *T. dicoccum*

256. Borlaug was awarded Nobel prize for
(a) Discovering 'Norin genes' of dwarfness
(b) Introducing 'Norin genes' in Mexican varieties of wheat
(c) Handling wheat rust problem of India (d) Discovering bunt disease of wheat

257. Why wheat flour is useful in baking of bread? It is due to the higher content of
(a) Starch (b) Sugar (c) Protein (d) Gluten

258. Maize grains are poor in
(a) Thiamine and lysine (b) Thiamine and niacin
(c) Tryptophan and lysine (d) Tryptophan and thiamine

259. Botanical name of sweet-corn is
(a) *Zea mays* var *everta* (b) *Zea mays* var *amylacea*
(c)*Zea mays* var *indentata* (d) *Zea mays* var *tunicata*

260. Botanical name of pop corn is
(a) *Zea mays* var *tunicata* (b)*Zea mays* var *everta*
(c)*Zea mays* var *indentata* (d) *Zea mays* var *amylacea*

261. One pound of pea nut yields
(a) 636 *kcal* (b) 27 *kcal* (c) 200 *kcal* (d) 2700 *kcal*

262. Ground nut is a native of
(a) India (b) Africa (c) Brazil (d) USSR

263. The largest ground nut producing country in the world is
(a) Brazil (b) USA (c) India (d) Myanmar

264. The oil obtained from the colyledons of *Arachis hypogea* is
(a) An essential oil (b) A drying oil
(c) A non-essential non-drying oil (d) An essential drying oil

265. *TG*-1, *TG*-3 and *TG*-18 are improved varieties of ground nut. They are produced by
(a) Interspecific crossing (b)Intergeneric hybridizaiton
(c) Pureline selection (d)Gamma rays mutations

266. Among the following which one is the richest source of protein

(a) Soyabaen (*Glycine max*) (b)Wheat (c) Rice (d) Gram

267. In India, a simple technology has been developed for farmers to use two plants as biofertilizers for growing rice

(a) *Azolla* and nitrogen fixing blue-green algae (b) *Leuconea* and *Eucalyptus*

(c) *Chlorella* and *Spirulina* (d) *Azatobacter* and *Rhizobium*

268. Which of the following plant seeds are used as 'jeweller's weight'

(a) *Cajanus cajan* (b) *Lens culinaris* (c) *Glycine max* (d) *Abrus precatorious*

269. One of the major '*Basmati*' rice producing state of our country is

(a) Andhra Pradesh (b) Kerala (c) Karnataka (d) Uttar Pradesh

270. Brown leaf spot disease of rice is caused by

(a) *Helminthosporium oryzae* (b) *Phytophthora infestans*

(c) *Puccinia graminis* (d) *Xanthomonas oryzae*

271. The resistant variety of rice to bacterial blight is

(a) Jaya (b) TMK-6 (c) IR-20 (d) IR-8

272. The storage pathogen of rice is

(a) *Helminthosporium oryzae* (b) *Piricularia oryzae*

(c) *Xanthomonas oryzae* (d) *Calanoluca oryzae*

273. Which variety of Barley has a higher protein content and more suited as food

(a) Two-rowed variety (b) Four-rowed variety (c) Six-rowed variety (d) All the above

274. Which variety of Barley suits best in the production of malt whisky, beet and other alcoholic beverages

(a) Two-rowed variety (b) Four-rowed variety (c) Six-rowed variety (d) Any of the above

275. Which of the following is a pulse crop

(a) *Phaseolus vulgaris* (b) *Glycine max* (c) *Cajanus cajan* (d) *Vicia faba*

276. Botanical name of green and black gram respectively is

(a) *Phaseolus aureus* and *P. mungo* (b)*Phaseolus radiatus* and *P. mungo*

(c) *Cajanus cajan* and *P. aureus* (d) *Phaseolus radiatus* and *Cajanus cajan*

277. Common pulse pest is

(a) Slug and snails (b) Brunches (c) Calendula (d) Bugs and mites

278. Why pulse crop is not manured with nitrogenous fertilizers? Because their roots are

(a) Non-nodulated (b) Nodulated (c) Unable to utilize N_2 (d) Apogeotropic

279. Which of the following have a higher protein content

(a) Cereals (b) Millets (c) Pulses (d) Vegetables

280. Major gram (Chick pea) growing country is

(a) Mexico (b) Italy (c) India (d) USA

281. Which of the following is a pseudo-cereal crop
(a) Maize/*Zea mays* (b) Barley/*Hordeum vulgare*
(c) Buck wheat/*Fagopyrum esculentum* (d) Rice/*Oryza sativa*

282. Buck wheat yields 'Kutu' flour commonly used in religious fast. The plant belongs to
(a) Gramineae (b) Leguminoseae (c) Polygonaceae (d) Poaceae

283. Broom corn is obtained from
(a) *Sorghum* (b) *Borassus* (c) *Attalia* (d) None of the above

284. Starch grains in rice are
(a) Simple and concentric (b)Simple and eccentric (c)Dumbell shaped (d) Compound

285. Food grains which provide the most important staple food for man are
(a) Legume (b) Cereals (c) Oil seeds (d) Millets

286. Bunt of wheat is caused by
(a) *Puccinia graminis* (b) *Ustilago triticei* (c) *P. glumarum* (d) *Neovossia indica*

287. Who first studied the wheat rust problem in India
(a) Butler (b) Dastur (c) K.C. Mehta (d) T.S. Sadashivan

288. *Puccinia graminis triticei* is the cause of
(a) Smut of wheat (b) Black stem rust of wheat
(c)Loose smut of wheat (d) White rust of wheat

289. Mud-ball technique for rice cultivation has been proposed by
(a) IARI, New Delhi (b) IRRI, Philippines (c) CRRI, Cuttuck (d) CSIR, New Delhi

290. '*Taichung*' is a dwarf variety of rice. It is native of
(a) Philippines (b) Japan (c) Taiwan (d) India

291. Maize belongs to
(a) Cereals (b) Millets (c) Pulses (d) Oil crop

292. Indian-corn is a native of
(a) North India (b) Tropical South America
(c)Africa and India (d) South Europe

293. Which of the following food grains have never been reported from any of the archaeological excavations in India
(a) Wheat (b) Barley (c) Rice (d) Maize

294. Why maize is not mentioned in any of the ancient literature prior to sixteenth century? Because
(a) Maize got evolved after 16th century (b) Maize was not liked by ancient people
(c) Maize was a wild plant growing in forests (d) Maize was introduced from new world after its discovery in 1942

295. Maize grains are rich in
(a) Thiamine (b) Niacin (c) Lysine (d) Thymine

296. Centre of origin of cultivated tetraploid wheat (*Triticum durum* and *T. dicoccum*) is
(a) Mexico (b) India (c) Mediterranean region (d)Middle-east

297. Centre of wheat breeding and research in India is
(a) NBG, Lucknow (b) CRRI, Cuttuck (c) IARI, New Delhi (d) Pusa, Bihar

298. What is tetraploid solid wheat and hexaploid club wheat
(a) *T. spelta* and *T. durum* respectively (b) *T. compactum* and *T. turgidum* respectively
(c) *T. turgidum* and *T. compactum* respectively (d) *T. aestivum* and *T. spelta* respectively

299. Which of the following is a diploid wheat
(a) Emmer wheat (b) Einkorn wheat (c) Club wheat (d) Bread wheat

300. Which of the following pulses is not a native of India
(a) Gram/*Cicer arietinum* (b) Black gram/*Phaseolus mungo*
(c) Green gram/*Phaseolus aureus* (d) All the above

301. Centre of origin of gram is
(a) Mexico (b) Spain (c) South Europe (d) South-east Asia

302. Which of the following pulses is not grown in Kharif season
(a) *Cicer arietinum* (b) *Cajanus cajan* (c) *Phaseolus mungo* (d) *Phaseous aureus*

303. Which of the following is predominately a self-pollinated crop
(a) Maize (b) Rice (c) Gram (d) All of these

304. Which of the following are the wild relatives of the cultivated rice
(a) *Oryza perenis* (b) *Oryza nivara* (c) *Oryza rufipogon* (d) All the above

305. An improved variety of rice IR-8 has been introduced in India from
(a) Bangladesh (b) Japan (c) Philippines (d) Taiwan

306. International Rice Research Institute (IRRI) is situated in
(a) China (b) Japan (c) Philippines (d) India

307. Majority of high yielding varieties of 'Indian rice' have been developed by cross between
(a) *O. sativa indica* × *O. nivara* (b) *O. nivara* × *O. sativa japonica*
(c) *O. sativa japonica* × *O. sativa indica* (d) *O. nivara* × *O. rufipogon*

308. The edible part of wheat and rice is
(a) Endosperm (b) Pericarp (c) Stigma (d) Style

309. Among the following vegetarian food items, which one is considered to be more rich in proteins
(a) Bread (b) Rice (c) Potato (d) Pulses

310. Which of the following depends on man for its cultivation and will vanish without men's help
(a) Rice (b) Maize (c) Wheat (d) Potato

311. Wheat, paddy and other cereals which form, the staple food of mankind belong to the family
(a) Asteraceae (b) Scitamineae (c) Palmae (d) Poaceae

312. Pea nut (*Arachis hypogea*) belongs to the family
(a) Papilionaceae (b) Poaceae (c) Palmaceae (d) Musaceae

313. In India the state famous for peanut cultivation is
(a) Gujrat (b) Maharashtra (c) Punjab (d) Tamil Nadu

314. Pulses are group of plants that belong to the family
(a) Compositeae (b) Cruciferae (c) Leguminosae (d) Malvaceae

315. Which of the plant is not related to Leguminosae
(a) Green gram (b) *Saraca* (c) Paddy (d) *Tamarid*

316. Flint rice has a
(a) High dextrin and high amylose (b) High dextrin and low amylose
(c) Low dextrin and high amylose (d) Low dextrin and low amylose

317. Germinating barley seeds are used in preparation of
(a) Cheese (b) Wine (c) Beer (d) Lactic acid

318. Gram belongs to the family
(a) Gramineae (b) Papilionaceae (c) Compositae (d) Solanaceae

319. Which is the main crop of Asia
(a) Wheat (b) Rice (c) Maize (d) Barley

320. The largest wheat producing country is
(a) India (b) U.K. (c) U.S.A. (d) Japan

321. Quite often pulse crops are not manured with nitrogenous fertilizers. It is so because
(a) These do not need nitrates (b) These have nodulated roots
(c) These do not have nodulated roots (d) These do not require nitrogen

322. Which one of the following countries is the center of origin of rice
(a) India (b) China (c) Indo-Malayan region (d)Russia

323. RR-21 is high yielding variety of
(a) Rice (b) Wheat (c) Gram (d) Sugarcane

324. BGA is chiefly used as bio-fertilizer in the crop of
(a) Wheat (b) Gram (c) Paddy (d) Mustard

325. Ground nut belongs to the family
(a) Fabaceae (b) Brassicaceae (c) Gramineae (d) Malvaceae

326. Cereals are major sources of
(a) Carbohydrates (b) Proteins (c) Fats (d) Vitamins

327. The most important cereal at world level is
(a) Wheat (b) Maize (c) Rice (d) Oat

328. The credit of introducing genes of dwarfness in wheat goes to
(a) Norman Berlang (b) M.S. Swaminathan (c) B.P. Pal (d) None of the above

329. Pulses are rich in proteins because
(a) Plants are supplied with more manure (b) Plants are irrigated
(c) Plants roots have property of N_2 fixation (d) Plants are cultivated in fertile soil

330. *Cicer arietinum* is known as
(a) Black gram (b) Green gram (c) Bengal gram (d) Dew gram

331. 'Central Rice Research Institute' is situated in

(a) Lucknow (b) New Delhi (c) Cuttack (d) Bangalore

332. Cultivation of ground nut in India is highest in

(a) Gujarat (b) Kerala (c) Bihar (d) Assam

333. Largest area under cultivation is of

(a) Jute (b) Cotton (c) Wheat (d) Sugarcane

334. Major food crops of the world belong to the family

(a) Leguminosae (b) Cruciferae (c) Solanaceae (d) Graminae

335. The wheat grain is a

(a) Fruit (b) Seed (c) Embryo (d) Glume

336. Pulses belongs to the family

(a) Papilionaceae (b) Solanaceae (c) Malvaceae (d) Gramineae

337. Botanical name of 'Bajra' (Pearl millet) is

(a) *Eleusine coracana* (b) *Sorghum vulgare* (c) *Pennisetum typhoides* (d) *Oryza sativa*

338. Botanical name of 'Moong' (Green gram) is

(a) *Phaseolus mungo* (b) *Phaseolus aureus* (c) *Cajanus Cajan* (d) *Glycine max*

339. In *Triticum vulgare*, chromosome number is

(a) $2n = 42$ (b) $2n = 28$ (c) $2n = 14$ (d) $2n = 32$

340. Rice grain contains about

(a) 80% carbohydrate (b) 90% carbohydrate (c) 100% carbohydrate (d) 60% carbohydrate

341. Germinated seeds of gram is recommended against

(a) Tiredness (b) Anaemia (c) Scurvy (d) Rickets

342. $2n = 28$ found in chromosome number is

(a) *Triticum turgidum* (b) *Triticum poeonicum* (c) *Triticum durum* (d) All the above

343. Crossing between wild Einkorm and grass *Aegilops speltoides* results in the …… variety of wheat

(a) Tetraploid (b) Hexaploid (c) Octaploid (d) Diploid

344. High yielding variety of wheat is

(a) Sonika (b) Sharbati (c) Sonara (d) All the above

345. The main ingredient of south Indian dishes is

(a) Green gram (b) Black gram (c) Wheat (d) Chana

346. Which of the following pulse cause disease of human beings

(a) *Pisum sativum* (b) *Cicer arietinum* (c) *Cajanus cajan* (d) *Lythyrus sativus*

347. Bengal gram or chick pea is obtained from genus

(a) *Cicer* (b) *Cajanus* (c) *Glycine* (d) None of the above

348. Which of the following high protein containing nuts

(a) *Prunus* (b) *Pistacia* (c) Both (a) and (b) (d) None of the above

349. Which of the following is a nut with high carbohydrate

(a) *Castanea sativa* (b) *Fugus sylvatica* (c) *Pistacia* (d) None of the above

350. Storage pathogen of rice is

(a) *Xanthomonas oryzae* (b)*Helminthosporium oryzae*

(c) *Calanohua oryzae* (d)*Piricularia oryzae*

351. Among the following which one is the richest sources of proteins

(a) Wheat (*Triticum vulgare*) (b) Rice (*Oryza sativa*)

(c) Gram (*Cicer arietinum*) (d) Ground nut (*Arachis hypogea*)

352. Maize grass is

(a) Annual (b) Binial (c) Perinial (d) None of the above

353. *Secale cereale* is used for making bread especially in

(a) India (b) European countries (c) Both (a) and (b) (d) None of the above

354. The germplasm for preparing hybrid varieties of maize was imported in India from

(a) Maxico (b) Cuba (c) America (d) All the above

355. One of the following is a Gift of new world to old world

(a) Wheat (b) Maize (c) Barley (d) Rice

356. Approximately one hundred diseases and pests are reported on

(a) Wheat (b) Gram (c) Ground nut (d) Rice

357. The principal cereal crop in India is

(a) Wheat (b) Rice (c) Maize (d) Sorgham

FRUITS , VEGETABLES AND SPICES

Basic Level

358. Which of the following provides delicious drink with luxative and diuretic property

(a) Cashew nut (b) *Areca nut* (c) Coconut (d) None of the above

359. Which constitute good food for diabetic persons

(a) Potato tuber (b) Sweet potato (c) Artichoke tubers (d) All the above

360. The cheapest high energy fruit crop of India is

(a) Banana (b) Guava (c) Apple (d) Mango

361. The most important foods are derived from

(a) Roots (b) Fruits (c) Stem (d) Leaves

362. Pod of *Dolichos lablab* is used as

(a) Vegetable (b) Pulse (c) Both (a) and (b) (d) None of the above

363. *Cichorium intybus* (chicory) belongs to the family

(a) Asteraceae (b) Apiaceae (c) Poaceae (d) Brassicaceae

364. Vegetable crop cultivation is know as

(a) Horticulture (b) Sericulture (c) Silviculture (d) Apiculture

365. Fruit pulp of which plant yield commercial oil

(a) *Arachis hypogea* (b) *Olea eurocarpa* (c) *Ricinus communis* (d) *Linum*

366. Camphor is obtained from which part of the following

(a) *Cinnamomum camphora wood* (b) *C. camphora leaf*

(c) *C. camphora flowers* (d) All the above

367. Ginger is a

(a) Bulb (b) Tuber (c) Rhizome (d) Corm

368. Which type of fruit is found in rice

(a) Legume (b) Caryopsis (c) Drupe (d) Berry

369. Richest source of vitamin '*C*' is

(a) *Capsicum fruitescene* (b)*Emblica officinalis* (Amla)

(c) Orange (d)Lemon

370. The edible part of groundnut is buried in the soil and morphologically it is a

(a) Root (b) Stem (c) Fruit (d) Leaf

371. Which of the following is the new world spice that has become an essential part of Indian cuisine

(a) Red pepper (b) Cardamom (c) Ginger (d) Black pepper

372. Food part of cauliflower is a modification of

(a) Terminal bud (b) Inflorescence (c) Leaf (d) Stem

373. Complex inflorescence of which plant is used as food

(a) *Rhaphanus sativus* (b) *Brassica repa* (c) *Brassica olirecia* (d) Mustard

374. Starch is stored in potato tuber because sugar is

(a) Synthesized in the leaf (b) Changed to starch in tuber

(c) Synthesized in the tuber (d) Transported from leaf to tuber

375. Which of the oil cake is used in the preparation of sweets

(a) Sunflower (b) Coconut (c) Cotton seed oil (d) None of the above

VEGETABLES , OILS , ESSENTIAL OILS AND FATS

Basic Level

376. Which of the oil is used in microscopic work

(a) Khas oil (b) Lavender oil (c) Clove oil (d) All the above

377. Which of the following oils are called fixed oils

(a) Essential oil (b) Fatty oils (c) Both (a) and (b) (d) All the above

378. Which of the oil is used in the preparation of paints and varnishes

(a) Linseed oil (b) Tung oil (c) Soyabean oil (d) All the above

379. Hemp oil is obtained from
(a) Leaf of Bhang (b) Roots of Bhang (c) Seeds of Bhang (d) All the parts

380. Poppy oil is used as edible oil even if the plant is having narcotic properties and oil has
(a) Normal oily property (b)Narcotic property (c) Highly narcotic (d) None of the above

381. *Ricinus communis*, which yields castor oil, belongs to the family
(a) Meliaceae (b) Pedaliaceae (c) Cruciferae (d) Euphorbiaceae

382. *Sesamum indicum*, from which sesame oil is obtained, belongs to the family
(a) Meliaceae (b) Euphorbiaceae (c) Cruciferae (d) Pedaliaceae

383. Castor oil is obtained from
(a) *Ricinus communis* (b) *Brassica campestris* (c) *Azadirachta indica* (d) *Sesamum indicum*

384. Which of the following oil is used in the preparation of typewriter ink
(a) *Linum* oil (b) *Brassica* oil (c) Chir oil (d) None of the above

385. Which is a non-drying oil
(a) Olive oil (b) Ground nut oil (c) Castor oil (d) All the above

386. Which of the following is semidrying oil
(a) Cotton seed oil (b) Corn oil (c) All the above (d) Sesame oil

387. Which of the following oil is drying oil
(a) Soyabean oil (b) Castor oil (c) Linseed oil (d) All the above

388. Terpentine oil is obtained from
(a) *Pinus longifolia* (b) *Melia azadirachta* (c) *Eucalyptus* (d) All the above

389. Oil of peppermint is
(a) Liquid at room temperature (b) Solid at room temperature
(c) Semisolid at room temperature (d) None of the above

390. Pea nut or ground nut of commerce from which vegetable oil is obtained belongs to genus
(a) *Phaseolus aureus* (b) *Pisum sativum* (c) *Cajanus cajan* (d) *Arachis hypogea*

391. Indian rape oil is obtained from
(a) *Azadirachta indica* (b) *Brassica campestris* (c) *Ricinus communis* (d) *Sesamum indicum*

392. Saff flower (*Carthamus tinctorius*) is
(a) An oil seed crop (b) An ornamental plant (c) Medicinal plant (d) Weed

393. Which of the oil is useful as a leather lubricant
(a) Brassica oil (b) Castor seed oil (c) Linseed oil (d) None of the above

394. Which part of *Arachis hypogea* is used for preparation of vegetable ghee
(a) Husk of fruit (b) Cake of seed (c) Oil of seeds (d) None of the above

395. Clove oil is obtained from
(a) Wood of *Santalum* (b) Leaves of *Syzygium aromaticum*
(c) Flower buds of *Syzygium aromaticum* (d) Rhizome of *Vativaria*

396. Sunflower is principally cultivated for its
(a) Starch (b) Protein (c) Alkaloid (d) Oil seed crop

397. Which of the oil is used as a purgative drug

(a) Ground nut oil (b) Castor seed oil (c) Cotton seed oil (d) All the above

398. Which of the following oil is poisonous purgative

(a) *Ricinus communis* (b) *Arachis hypogea* (c) *Jatropha curcus* (d) All the above

399. Which of the oil is very useful for preparation of soap of washing cloths

(a) *Brassica rapa* (b) *Madhuca indica* (c) *Melia* (d) None of the above

400. Fatty oils are of

(a) Drying type (b) Semidrying type (c) Non-drying type (d) All the above

401. An important oil yielding plant is

(a) *Carthamus tinctorious* (b)*Cicer arietinum* (c) *Lens esculantum* (d) *Eleusine corcana*

402. A genus of ornamental plants which is being cultivated for extracting an important edible oil from its Cypsela fruits is

(a) *Helianthus* (b) *Brassica* (c) *Sesamum* (d) *Cocos*

403. Which of the oils are hydrocarbons

(a) Fatty oils (b) Essential oils (c) Both (a) and (b) (d) None of the above

404. Khas oil is obtained from which part of the *Vetiveria*

(a) Leaf (b) Flower (c) Root and rhizome (d) None of the above

405. Essential oils are those which are

(a) Used in soap manufacture (b) Used in perfumes

(c) Essential for plant producing them (d) Essential for human kind

406. 'Gingelly oil' or 'Til oil' is obtained from the seeds of

(a) *Arachis hypogea* (b) *Brassica compestris* (c) *Carthamus tinctorius* (d)*Sesamum indicum*

407. One of the following is an oil seed crop

(a) Sunflower (b) Rose (c) Marigold (d) *Chrysanthemum*

408. Oil yielding plants are abundant in the family

(a) Solanaceae (b) Ranunculaceae (c) Cruciferae (d) Curcurbitaceae

409. Lemon grass oil is extracted from

(a) *Bambusa beecheyana* (b)*Cymbopogon citratus*

(c)*Cymbopogon nardus* (d)*Cymbopogon martinii*

410. Which of the following is not an essential oil

(a) Clove oil (b) *Eucalyptus* oil (c) Sandal wood oil (d) Ground nut oil

411. The Botanical name of 'Indian Rye' is

(a) *Brassica campestris* (b) *B. juncea* (c) *B. nigra* (d) *B. alba*

412. Ground nut oil is a

(a) Non-drying oil (b) Essential oil (c) Drying oil (d) None of the above

413. The fleshy mesocarp of a plant is the source of palm oil which is now in common use as an edible oil. This plant is known by the botanical name

(a) *Metroxylon rumphii* (b) *Elaeis guinensis* (c) *Phoenix sylvestris* (d) *Calamus rotung*

414. Castor oil producing plant belongs to family

(a) Compositae (b) Cruciferae (c) Euphorbiaceae (d) Palmae

415. Important use of which of the following is as a lubricant

(a) *Helianthus annus* (b) *Carthamus tinctorious* (c)*Ricinus communis* (d)*Cocos nucifera*

416. Non-essential cotton seed oil and ground nut seed oil is obtained from cotyledons. These oils are

(a) Drying type (b) Semi-drying type

(c) Non-drying and semi-drying respectively (d) Semi-drying and non-drying respectively

417. Which of the following is the source of oil and protein both

(a) *Cajanus cajan* (b) *Gossypium* (c) *Glycine max* (d) *Phaseolus vulgare*

418. Which of the following is an oil yielding tree crop of south India

(a) *Arachis hypogea* (b) *Brassica campestris*

(c) *Ricinus communis* (d) *Gossypium herbaceum*

419. From which plant-seeds oil is obtained

(a) *Saccharum officinarum* (b)*Saccharum munja* (c) *Arachis hypogea* (d) *Cicer arietinum*

420. In cotton and castor seed, the oil is respectively stored in

(a) Endosperm and cotyledons (b) Cotyledons and endosperm

(c) Endosperm in both (d) Perisperm and endosperm

421. In ground nut (*Arachis hypogea*) oil is stored in

(a) Endosperm (b) Cotyledons (c) Embryo (d) Tuber

422. Palm oil is extracted from

(a) *Glycine* (b) *Gossypium* (c) *Elacis* (d) *Olea*

RESINS , RUBBER , LATEX , DYE AND SUGAR

Basic Level

423. Canesugar is obtained from genus

(a) *Saccharum officinales* (b)*Beta vulgaris* (c) *Acer saccharum* (d) All the above

424. Roots of *Beta* are

(a) Fusiform (b) Nepiform (c) Conical (d) None of the above

425. Sugarcane is a member of

(a) Chenopodiaceae (b) Nyctagenaceae (c) Graminae (d) None of the above

426. The annual rainfall required for sugarcane crop is

(a) 100 *cm* (b) 200 *cm* (c) 250 *cm* (d) None of the above

427. Sugarcane is cultivated through

(a) True seeds (b) Vegetative propagules (c) Through leaf (d) By root cutting

428. Sugar yielding part of sugarcane is

(a) Root (b) Leaf (c) Stem (d) All the above

429. Majority of improved varieties of sugarcane are produced by crosses between Noble-cane and Cob-cane, which are respectively

(a) *Saccharum robustum* and *S. spontaneum* (b) *S. spontaneum* and *S. officinarum*

(c) *S. officinarum* and *S. robustum* (d) *S. officinarum* and *S. spontaneum*

430. Major source of sugar in Europe and India is respectively

(a) Sugarcane (b) Sugarcane and beet root

(c)Date palm and sugarcane (d) Beet root and sugarcane

431. *Saccharum officinarum* yields

(a) Glucose (b) Fructose (c) Sucrose (d) Galactose

432. Sugar obtained from sugarcane and sugarbeet is

(a) Glucose (b) Fructose (c) Galactose (d) Sucrose

433. Sugar yielding part of *Beta vulgaris* is

(a) Leaf (b) Shoot (c) Root (d) All the above

434. Lime, CO_2 and SO_2 is used for purification of juice of

(a) Sugarcane (b) *Beta vulgaris* (c) Both (a) and (b) (d) None of the above

435. Which of the following plant yield sugar

(a) *Acer saccharum* (b) *Acer nigrum* (c) Both (a) and (b) (d) None of the above

436. Palm sugar is obtained from

(a) *Phoenix sylvestris* (b) *Cocos nucifera* (c) *Caryota urens* (d) All the above

437. *Hevea* yields

(a) Bast resin (latex) (b) Soft fibre (c) Delicious soft drink (d) Strong fibre

438. Beet root belongs to family

(a) Chenopodiaceae (b) Apocynaceae (c) Asclepiadaceae (d) Cruciferae

439. Dry fibrous residue left after the extraction of sugar from sugarcane is

(a) Cane (b) Molasses (c) Bagasse (d) Pulp

440. Indian Sugarcane Breeding Research Institute (SBRI) is situated at

(a) New Delhi (b) Lucknow (c) Madras (Chennai) (d) Coimbatore

441. SBRI was established in

(a) 1810 (b) 1912 (c) 1937 (d) 1947

442. *National Botanical Research Institute* is located at

(a) Calcutta (b) Hyderabad (c) Madras (Chennai) (d) Lucknow

443. *Hevea braziliensis* is a source of

(a) Rubber (b) Spice (c) Beverage (d) Dye

444. Major source of sugar in the world is

(a) Watermelon (b) Beet root (c) Sugarcane (d) Dates

445. Which state in India is the largest producer of sugarcane

(a) Bihar (b) Andhra Pradesh (c) Punjab (d) Uttar Pradesh

446. The important source of sugar in India is
(a) *Solanum tuberosum* (b) *Saccharum officinarum*
(c)*Saccharum munja* (d) *Triticum aestivum*

447. Sugarcane research institute, Coimbatore has developed red rot resistant varieties as
(a) *Co*-419 (b) *Co*-421 (c) *Co*-527 (d) All the above

448. *Co*-419 and *Co*-527 are improved varieties of
(a) Wheat (b) Rice (c) Cotton (d) Sugarcane

449. Highest crop of sugarcane is grown in the world in
(a) India (b) Pakistan (c) America (d) Australia

450. Sugarcane cultivated in a region with temperature ranging between
(a) 10°*C* - 20°*C* (b) 20°*C* - 25°*C* (c) 25°*C* - 30°*C* (d) 30°*C* - 40°*C*

451. Which of the following is not a variety of sugarcane
(a) *BO*-11 (b) *CO*-419 (c) *HM*-320 (d) *CC*-464

452. Wax is obtained from
(a) Jojoba (b) Guayule (c) Leucaena (d) Subabul

453. 'Central Sugarcane Breeding Research Insititute' is situated at
(a) Lucknow (b) Delhi (c) Coimbatore (d) Bhopal

454. *Glycine max* is used for preparing
(a) Artificial milk (b) Tea (c) Coffee (d) None of the above

455. Stilt roots are found in
(a) Rice (b) Sugarcane (c) Groundnut (d) Gram

456. The major source of sugar in India is
(a) *Solanum nigrum* (b) *Helianthus tuberosus* (c) *Saccharum officinarum* (d)None of the above

457. Baggase is related to the manufacture of
(a) Canesugar (b) Cellulose (c) Cinchonidine (d) Resin

458. Among the following which harms the sugarcane crop
(a) *Pyrilla* (b) Termites (c) Locusts (d) *Piricularia*

459. Axillary buds are used to raise crop of
(a) Wheat (b) Rice (c) Groundnut (d) Sugarcane

460. Sugarcane juice contains
(a) Sucrose only (b) Sucrose + maltose (c) Sucrose + pactose (d) Sucrose + lactose

461. *Pyrilla perpusila* is common pest on
(a) Rice (b) Wheat (c) Pulses (d) Sugarcane

PETROLEUM , COAL AND ALCOHOL FREE

Basic Level

462. Younger coal deposits are of the age
(a) Cambrian (b) Silurian (c) Permian (d) Cretaceous

463. Best types of fossils are obtained in the form of
(a) Compressions (b) Castes (c) Coal balls (d) None of the above

464. Coal deposits of tertiary and cretaceous age are found in
(a) Raniganj (b) Rajmahal hills (c) Andaman and Nicobar (d)All the above

465. First coal fields of India are those of
(a) Andaman and Nicobar (b)Raniganj and Jharia
(c)Umaria and Chanda (d)None of the above

466. Which one is not a petroleum product
(a) Naphtha (b) Benzene (c) Paraffin (d) None of the above

467. Petroleum is also called
(a) Naphtha (b) Rock oil (c) Mineral oil (d) All the above

468. Which is a fossil
(a) Diatomaceous earth (b) Coal (c) Petroleum (d) All the above

469. Which types of fossils are found in the form of coal balls
(a) Petrifactions (b) Impressions (c) Compressions (d) All the above

470. Which of the following is regarded as the coal age
(a) Silurian (b) Devonian (c) Carboniferous (d) Coenozoic

471. Existence of coal and petroleum may be detected with the study of
(a) Palaeobotany (b) Ecology (c) Bacteriology (d) Economic Botany

472. L.P.G. cooking gas is
(a) Low pressure gas (b) Biogas (c) Fossil fuel (d) Low price gas

473. The family/families which possesses the plants that are responsible for the formation of liquid fuel is/are
(a) Euphorbiaceae (b) Asclepiadaceae (c) Apocynaceae (d) All the above

474. In India petroleum is found in
(a) Gujrat (b) Assam (c) Bombay-High (d) All the above

475. According to the present estimates …… of the world's petroleum will be exhausted by the year 2025
(a) 70% (b) 80% (c) 90% (d) 100%

476. Vitis is a tendril climber, a species which is extensively used for
(a) Charas (b) Wine (c) *Opium* (d) Volatile oil

477. Coal was first dig in 1239 in
(a) Kuwait (b) USA (c) England (d) India

478. Coal mining started in India from

(a) 17th century (b) 18th century (c) 19th century (d) 16th century

479. Coaltar, coal gas and coke are related product of

(a) Coal (b) Petroleum (c) (a) and (b) both (d) None of the above

480. Each coal ball is a mass of

(a) Calcium carbonate (b) Magnesium carbonate (c) Iron sulphide (d) All the above

481. Petroleum is derived from words 'Petra meaning rock and 'Oleum' meaning oil. Words 'Petra' and 'Oleum' are

(a) Greek words (b) Latin words (c) Indian words (d) Chinese words

482. The pioneer country in the production of fuel alcohol is

(a) Suadi Arabia (b) Iran and Iraq (c) Brazil (d) Japan

483. Coal is

(a) Renewable source (b) Non-renewable source (c)Cycling source (d) All the above

484. Petroleum plant is

(a) *Euphorbia lathyrus* (b) *Brickellia* sp. (c) *Albizia* (d) Both (a) and (b)

485. Possibilities of presence of coal in a particular area can be guessed by the study of

(a) Economic botany (b) Ecology (c) Pollen grains analysis (d) Mining the area

486. Most of the petrocrops belong the family

(a) Leguminosae (b) Euphorbiaceae (c) Rutaceae (d) Malvaceae

487. As a result of pyrolysis, which one of the following is produced

(a) Alcohol (b) Charcoal

(c) Charcoal and gas (d) Charcoal, gas and oil

488. Who is credited with identifying petro-crops

(a) Swaminathan (b) Calvin (c) Krebs (d) Borlang

489. Domestic cooking gas cylinder is filled with

(a) Alcohol (b) Diesel oil (c) Liquid petroleum gas (d)Coal gas

490. Gobar gas contains mainly

(a) $CH_4 + CO_2$ (b) $CH_4 + O_2$ (c) $CO_2 + H_2$ (d) $CO_2 + H_2O$

491. Institute of Palaeobotany is situated at

(a) Delhi (b) Lucknow (c) Allahabad (d) Aurangabad

492. *Secale cerelae* is a used for the preparation of

(a) Wine (b) Beer (c) Both (a) and (b) (d) None of the above

493. The most important energy yielding constituent in biogas is

(a) H_2S (b) C_2H_4 (c) CH_4 (d) C_2H_2

494. For biogas production besides dung an extensive use of which weed is recommended in our country

(a) *Mangifera indica* (b) *Hydrilla* (c) *Eichornia crassipes* (d) *Solanum*

MISCELLANEOUS PROBLEMS

Basic Level

495. Aconite is obtained from

(a) Tuberous roots (b) Stem (c) Leaves (d) Seeds

496. Cardamoms or Cardamons are ripe and dried fruits of

(a) *Elettaria cardamomum* (b)*Cinnamomum zeylenicum*

(c) *Eugenia caryophyllata* (d)*Zingiber officinale*

497. Of the following plants which one would you consider an endangered plant due to over exploitation

(a) Dioscorea (b) Maize (c) Wheat (d) Rice

498. What is meant by the term 'Karalam'

(a) Land of coconut (b) Land of areca nuts (c) Land of pea nuts (d) None of the above

499. Bhojpatra is derived from

(a) Bark of *Cinchona* (b) Bark of *Dalbergia* (c) Bark of *Betula utillis* (d) Leaves of *Piper*

500. Which of the following jam is used as antipurgative

(a) Jam of *Aegle* (b) *Citrus* fruits

(c) *Hibiscus esculentus* fruits (d) None of the above

501. *Myristica fragrans* is used as

(a) Medicine (b) Caudiment (c) Both (a) and (b) (d) None of the above

502. Finger millet belongs to genus

(a) *Eleusine* (b) *Penicum* (c) *Triticum* (d) None of the above

503. One of the plants introduced from old world to the new world is

(a) Sweet potato (b) Corn (c) Potato (d) Rice

504. *Heeng* of commerce is obtained from *Ferula asafoetida* (Umbelliferae) is a

(a) Stomach of deer (b) Waste petroleum product

(c)Resinous exudate of root (d) Diatoms

505. Which is not a source of drug

(a) *Aconitum napellus* (b) *Dalbergia sissoo* (c) *Papaver somniferum* (d) *Cannabis sativus*

506. Under ethnobotany, we study

(a) Relation of plant with environment (b) Relation of primitive plant with man

(c) Relation of plant with birds (d) All the above

507. Term 'ethnobotany' was proposed by

(a) Harshberger (b) Cornberg (c) Neuberg (d) None of the above

508. Digestive ferment 'bromelin' is obtained from

(a) Pomegranate (b) Pineapple (c) Both (a) and (b) (d) None of the above

509. Saffron plants belong to family

(a) Iridaceae (b) Araceae (c) Zingiberaceae (d) Liliaceae

510. The branch of science that deals with the development of forest and utilization of forest product is

(a) Horticulture (b) Sericulture (c) Silviculture (d) Pharmocognosy

511. In those plants whose pulp is of economical importance, they are generally propagated by vegetative means because

(a) It is cheaper (b) It is more economical

(c) The pulp quality remains same (d) The pulp quality becomes better

512. *Tapioca* plant which store food in large fleshy storage roots belongs to genus

(a) Manihot (b) *Ipoemaea* (c) *Dioscorea* (d) *Solanum*

513. One of the plant introduced from new world to the old world

(a) Wheat (b) Potato (c) Rice (d) Sugarcane

514. *Saffron* is produced from

(a) Roots (b) Petals

(c) Stamens (d) Style stigma of carpels of crocus plant

515. Mysore has one of the following institute

(a) National Agricultural Research Institute (b) Rice Research Institute

(c) Forest Research Institute (d) Central Food Technology Research Institute

516. A clove represents a

(a) Terminal bud (b) Accessory bud (c) Flower bud (d) Vegetative bud

517. Catechu is obtained from the

(a) Leaf of *Acacia* (b) Seeds of *Acacia* (c) Wood of *Acacia* (d) Roots of *Acacia*

518. *Madhuca indica* belongs to family

(a) Sapotaceae (b) Anacardiaceae (c) Both (a) and (b) (d) None of the above

519. Which of the following differs in its chief economic importance

(a) *Helianthus annus* (b) *Brassica juncea* (c) *Allium cepa* (d) *Arachis hypogea*

520. Which of the following pair of plants gives oil and fibre both

(a) *Gossypium* and *Brassica*

(b) *Brassica* and *Linum usitatissimum*

(c) Cotton and Flax

(d) Sunflower and *Brassica*

521. Match the following plants according to their family

Plants	**Family**
1. Lodh tree	I. Lecythidaceae
2. Quinine	II. Lauraceae
3. Kachnar	III. Symplocaceae

4. Indian oak — IV. Meliaceae
5. Dalchini — V. Caesalpiniaceae
6. Rohan — VI. Rubiaceae

Correct pair is

	1	2	3	4	5	6
(a)	I	II	III	IV	V	VI
(b)	VI	V	IV	III	II	I
(c)	III	VI	V	I	II	IV
(d)	II	I	IV	V	VI	III

522. *Piper betle* is the botanical name of

(a) Pan (b) Tulsi (c) Kali mirch (d) Long

523. Match the following

A	**B**
1. Amaltas	I. Plantaginaceae
2. Amla	II. Caesalpiniaceae
3. Afim	III. Euphorbiaceae
4. Pipalmul	IV. Papaveraceae
5. Bahera	V. Piperaceae
6. Isabgol	VI. Combretaceae

Correct pair is

	1	2	3	4	5	6
(a)	I	II	III	IV	V	VI
(b)	II	III	IV	V	VI	I
(c)	III	IV	V	VI	I	VII
(d)	IV	V	VI	I	II	III

524. The rhizome and stalk of male fern …… yield oleore sinous substance used for the expulsion of tapeworms

(a) *Dryopteris filix* (b) *Selaginella species* (c) *Lycopodium clavatum* (d) *Azolla*

525. *Asparagus* is a native of

(a) Europe and Western Asia (b) India (c) China (d) USA

526. Which part of the plant *Eugenia aromatica* do we use (in the form of cloves) as an aromatic spice

(a) Dried fruit (b) Dried and roasted seed
(c) Unopened dried flower bud (d) Dried leaf

527. Which of the following provides 3 important ingradients of our food namely carbohydrates, fats and proteins

(a) Ground nut (b) Gram (c) Castor (d) Mango

528. From which part of turmeric plant (*Curcuma longa*), the turmeric powder is obtained

(a) Seed (b) Dried rhizome (c) Dried root (d) Dried fruit

529. Lightest wood is

(a) *Hardwichia binata* (b) *Ochromoa lagopus balsa*
(c) *Cereus giganteus* (d) *Cycas*

530. Central institute of toxicology is at

(a) Lucknow (b) Madras (c) Bombay (d) Delhi

531. Lobia is

(a) *Vigna sinensis* (b) *Cajanus cajan* (c) *Phaseolus radiatus* (d) None of the above

532. Glycerine is obtained from

(a) Baggase (b) Molasses (c) Filter mud (d) All the above

533. Which of the following pair is used as condiments

(a) *Ferula* and *Papaver* (b) *Curcuma* and *Ferula*

(c) *Cinchona* and *Ferula* (d) *Cinchona* and *Papaver*

534. Where do you find cardamom hills

(a) Kerala (b) Madhya Pradesh (c) Uttar Pradesh (d) West Bengal

535. Nutmegs of commerce which is extensively used as spices belong to genus

(a) *Myristica* (b) *Eugenia* (c) *Cinnamomum* (d) *Acacia*

536. Which is not included in poaceae family

(a) Paddy (b) Wheat (c) Grasses (d) Mustard

537. The plant which is used as a source of spice as well as dye is

(a) Turmeric (b) Cardamom (c) Clove (d) Indigofera

538. Botanical name of tea is

(a) *Sinensis thea* (b) *Sinensis* (c) *Thea sinensis* (d) *Coffea arabica*

539. *Arachis hypogea* exhibits

(a) Epicarpy (b) Apocarpy (c) Geocarpy (d) Syncarpy

540. A milk like preparation can be made from the seed of

(a) *Vitis vinifera* (b) *Cicer arietinum* (c) *Glycine max* (d) *Hordeum vulgare*

541. Energy source which do not remove CO_2

(a) Oil (b) Coke

(c) Nuclear energy (d) Other organic substance

542. Which of the following is incorrect about *Adhatoda vasica*

(a) It is a perennial shrub (b)Flowers after rainy season

(c) Leaves contain alkaloid vascine (d) None of the above

543. Which one is not a millet

(a) *Triticum* (b) *Pennisetum* (c) *Panicum* (d) *Eleusine*

544. One of the following is a social foresting species with multiple utility

(a) *Mangifera indica* (Mango) (b) *Leucaena leucocephala* (Subabul)

(c) *Borassus flabelliformis* (Palmyrah palm) (d) *Rosa grandiflora* (Rose)

545. Timber is

(a) Secondary phloem (b) Phellem (c) Secondary cortex (d) Secondary xylem

546. Coffee plant belongs to

(a) Sterculiaceae (b) Rubiaceae (c) Annonaceae (d) Cruciferae

547. 'Indian Grassland and Fodder Research Institute' is located at

(a) Kanpur (b) Jhansi (c) Jodhpur (d) Hydeabad

548. The plant whose seeds yield safflower and the petals an orange dye is

(a) *Calendula officinalis* (b)*Helianthus annus*

(c) *Rauwolfia serpentina* (d)*Carthamus tinctorius*

549. The first transgenic crop was

(a) Pea (b) Flax (c) Tabacco (d) Cotton

550. *G. hirsutum* is

(a) New world tetraploid (b)Old world tetraploid

(c)New world diploid (d)Old world diploid

551. Major foreign exchange earner for our India is

(a) Tea (b) Coffee (c) Rice (d) Wheat

552. The inflorescence of Gramineae (Poaceae) is called

(a) Spike of spikelets (b) Cyme (c) Monopodial cyme (d) Raceme

553. 'Margarine' is prepared from

(a) Ground nut (b) Coconut (c) Almond (d) Cashewnut

554. Name the famous plant ecologist

(a) Jagdish Chandra Bose (b)Birbal Sahani (c) Ramdeva Mishra (d) Charles Darwin

555. *Areca catechu* and supari belongs to the family

(a) Poaceae (b) Palmae (c) Asteraceae (d) Scitamineae

556. Which of the following crop have been brought to India from new world

(a) Coffee (b) Mango, tea

(c) Tea, rubber, mango (d) Cachewnut, potato, rubber

557. Branch of Botany is connected with study of food, fibre and wood yielding plants

(a) Ethnobotany (b) Paleobotany (c) Economic botany (d) Microbiology

558. What is bran

(a) Predominantly starch (b)Predominantly proteins

(c) Predominantly lipids (d)Predominantly minerals

559. The economically important plant of malvaceae

(a) *Gossypium hirsutum* (b) *Hibiscus cannabis*

(c) *Abelmoschus esculantum* (d) All of these

560. In certain parts of India muscular distrophy is commonly found among the poor people because they eat cheap pulses of

(a) *Phaseolus mungo* (b) *Pisum sativum* (c) *Lathyrus sativus* (d) *Cicer*

561. Amongst the Indian Scientists who is associated with green revolution in India

(a) Dr. L.R. Tandon (b) Dr. C.V. Raman (c) Dr. J.C. Bose (d) Dr.S. Swaminathan

562. The tobacco plant *Nicotiana tobacum* belongs to the family

(a) Solanaceae (b) Euphorbiaceae (c) Urticaceae (d) Moraceae

563. Commercial cutch is obtained from the heart wood of

(a) *Acacia senegal* (b) *Acacia catechu*

(c) *Acacia arabica* (d) All of the above plants

564. Agricultural chemicals include

(a) Pesticides (b) Fertilizers (c) Growth regulators (d) All of these

565. In South East Asia, the basis of early agriculture was the planting of

(a) Millets (b) Legumes (c) Some cereals (d) Underground parts

566. Which of the following is most important source of food

(a) Lichen (b) Angiosperms (c) Algae (d) Fungi

567. The botanical name of the peepal tree is

(a) *Cajanus cajan* (b) *Ficus religiosa* (c) *Pisum sativum* (d) *Ficus benghalensis*

568. Snow rose belongs to genus

(a) Rheum (b) Rhododendron (c) Rumex (d) None of these

FOOD PRESERVATION

GENERAL

Basic Level

569. In preserved fruits

(a) Nutritive value is not reduced (b)There is attraction

(c) Moisture is developed (d)Nutritive value is lost

570. Bacteria present in food material becomes inactive

(a) By washing food material

(b) By keeping food material at a temperature of 4° – 10°*C*

(c) By keeping food in polythene bags

(d) By keeping food material in containers

571. While preparing sauce, chatni and jams, there should not be heating in iron made containers because

(a) Acid reacts with iron and develops black colour (b)Makes edible material poisonous

(c) Takes a longer time to ripe (d)Edible material becomes rusty

572. The solution of calcium chloride is used in the preservation of vegetables to make them stiff. What should be the concentration of the solution

(a) 2% (b) 3% (c) 4% (d) 5%

573. Preservative is necessary

(a) In cooking food (b) As a part of the meal

(c) To keep food material safe for future (d) All of these

574. Botulism caused by *Clostridium botulinum* attects the

(a) Spleen (b) Intestine (c) Lymph glands (d) Neuro-muscular junction

575. Which is more suitable in jelly preparation

(a) Sugar (b) Salt (c) Pectin (d) Protein

576. Botulism is a

(a) Type of food poisoning due to saprophytic *Clostridium botulinum* bacterium

(b) Disease of man due to parasitic bacteria

(c) Disease in various organisms

(d) Diseases of plants due to viruses

577. In fruit preservation which substance is used as preservative

(a) Calcium carbonate (b) Potassium metabisulphate

(c) Potassium nitrate (d) Ammonium sulphate

578. If in a little quantity of fruit juice, two spoons of spirit is added, then a white material in the form of clot is seen at the bottom of the container. This shows the presence of

(a) Sucrose (b) Glucose (c) Protein (d) Pectin

579. One simple measure to keep edible material free from fungi is

(a) To increase the moisture in edible material

(b) To add little acetic acid in the edible material

(c) To boil edible material for 10 minutes at 65°*C* temperature

(d) To keep edible material at 24°*C* temperature

580. Government of India in 1950 established 'Central Food Technological Research Institute' at

(a) Mysore (b) Calcutta (c) Madras (d) Bombay

581. Government of India in 1958 established 'Food Preservation Business Development Institute'. Its aim is to

(a) Keep control on food preservation business

(b) To issue licence to food preservation to food preservation business

(c) To provide raw material and equipment to food preservation business and to encourage export

(d) To encourage production of fruits

582. The main basis of food preservation is

(a) To increase the activity of enzyme

(b) To make enzyme and micro-organisms inactive

(c) To increase the activity of micro-organisms (d) To make food products tasty

583. To treat fruits with sulphur smoke before preservation is known as

(a) Blanching (b) Tanning (c) Canning (d) Moulding

584. To blanch vegetables

(a) Vegetables are kept in warm water for some time and later boiled for a short time

(b) Rind is removed and boiled for a long time

(c) These are boiled at 100°*C* temperature for 30 minutes

(d) Rind is removed

585. In blanching process, vegetables are

(a) Cooled (b) Warmed (c) Mixed with sugar (d) Filled in containers

586. Before putting in containers, the fruits and vegetables are kept in boiling water

(a) For 5 minutes (b) For 10 minutes (c) For 15 minutes (d) For 20 minutes

587. Which can preserve food stuffs

(a) Salt and Sugar (b) Sugar and Vinegar (c) Vinegar (d) All of these

588. Which substance is used at the time of washing of fruits

(a) Lime juice (b) Bleaching powder (c) Spirit (d) Brine solution

589. Which solution should be used to clean the fruits before preservation

(a) Salt solution (b) Alcohol solution

(c) Solution of bleaching powder (d) Lemon juice

590. Who discovered a scientific method for food preservation

(a) Nicholas Apart (1810) (b)Louis Pasteur

(c) William Underwood (1817) (d) Alexender Flemming

591. Most suitable temperature for the growth of micro-organisms is

(a) 30°*C* - 40°*C* (b) 35°*C* - 40°C (c) 25°*C* - 30°*C* (d) 15°*C* - 20°*C*

592. Which oil is mostly used for treatment in North India

(a) Til oil (b) Ground nut oil (c) Mustard oil (d) Coconut oil

593. Who adopted canning on commercial level for the first time

(a) America in 1817 (b) Russia in 1817 (c) France in 1860 (d) None of these

594. *Clostridium* makes food material preserved in containers poisonous. This is known as

(a) Freezing (b) Botulism (c) Canning (d) None of these

595. According to Indian Fruit Products Order (1955), two chemicals should be used for fruit preservation. These are

(a) Sodium benzoate and potassium metabisulphite (b)Citric acid and tartaric acid

(c) Acetic acid and tartaric acid (d) SO_2 and sulphuric acid

596. Temperature required to destroy spores of micro-organisms is

(a) 200°*F* - 250°*F* (b) 100°*F* (c) 275°*F* - 350°*F* (d) 400°*F*

597. Coldstore houses are the places where food products are preserved at commercial level. The products are stored at a temperature range of

(a) 0°*F* to 30°*F* (b) 30°*F* to 40°*F* (c) Always at 0°*F* (d) Always at 30°*F*

598. Food poisoning is caused by

(a) *Clostridium botulinum* (b)*Clostridium tumiaceae*

(c)*Salmonella typhosa* (d)*Synchytrium endobioticum*

599. By fruit preservation, diet's

(a) Nutritive value decreases (b) Nutritive value increases

(c) Variety and attraction increase (d) Nutritive value is lost

600. Temperature of refrigerator should be

(a) 1°*C* – 4°*C* (b) 4°*C* - 10°*C* (c) 11°*C* - 20°*C* (d) 20°*C* - 30°*C*

601. For food preservation chemical substances

(a) Should not be added (b) Should be added in traces

(c) More quantity should be added (d) None of the above

602. Jelly meter is used at

(a) 72°*F* (b) 80°*F* (c) 90°*F* (d) 100°*F*

603. Processing means

(a) Increasing the number of germs (b) Decreasing the number of germs

(c) Distruction of germs (d) Not to alter germs

604. In putrefaction, end products are

(a) Alcohol + gases (b) Fatty acid + glycerol

(c) Sugar + ammonia (d) Amino acid + ammonia

605. In food spoilage, microbes cause

(a) Only degradation (b) Synthesis of products (c) Both (a) and (b) (d) None of these

606. Before freezing of food, which is necessary

(a) Aseption (b) Washing

(c) Activation of enzymes by temperature (d) Steaming to activate the enzymes

607. Which chemical is used for preservation of meat

(a) Citric acid (b) Lactic acid (c) Nitrates (d) Sulphates

608. Modern method of preservation in

(a) Antibiotics (b) Hot water treatment (c) Sterilization (d) Pasteurization

609. Preservation of food by means of fermentation is known as

(a) Sterilization (b) Nairization (c) Vapourisation (d) None of these

610. In nairization, ratio of fruit pieces and sugar is

(a) 1 : 1 (b) 1 : 2 (c) 2 : 1 (d) 3 : 1

611. CO_2 is used as a preservative for preservation of

(a) Fruit candy (b) Ice cream (c) Soft drink (d) Alcoholic beverages

612. Chemical used in fish preservation is

(a) Sodium metabisulphate (b)Dry ice (c) Chlorotetracycline (d) Ethyl alcohol

613. Food material used by human may be

(a) Animal origin (b) Plant origin (c) (a) and (b) both (d) Edaphic origin

614. Protein is degraded by proteolytic organisms, these organisms are

(a) *Pseudomonas* (b) *Proteus* (c) Cocci (d) All of these

615. Pickles are pasteurized at

(a) 40°*C* to 50°*C* (b) 60°*C* to 70°*C* (c) 70°*C* to 80°*C* (d) 80°*C* to 90°*C*

616. Common salt and mustard oil are used as preservative for

(a) Meet (b) Vegetables (c) Alcoholic beverages (d) Pickles

617. Which antibiotic is used in preservation of food

(a) Penicillin (b) Oxytetracycline (c) Chlorotetracycline (d) Gentamycine

618. Waxing or paraffin coating is done to keep vegetables and fruits fresh, by doing so

(a) Temperature of fruits and vegetables is lowered

(b) Evaporation of moisture is checked

(c) Growth of micro-organism is inhibited (d) None of these

619. Preservation by deep freezing is

(a) Temporary (b) Permanent (c) Intermitant (d) All of these

620. Chemical added for preservation of fruit juices is

(a) Potassium metabisulphite (b) Potassium permanganate

(c) Potassium chloride (d) Potassium chlorate

621. The following is used as food preservative

(a) Sorbic acid (b) Sodium benzoate (c) Calcium propionate (d) All of these

622. The substance most commonly used as a food preservative is

(a) Sodium carbonate (b) Tartaric acid (c) Acetic acid (d) Benzoic acid

623. Seeds can be best preserved in

(a) Cool and dry condition (b)Cool and wet condition

(c) Hot and dry condition (d)Hot and wet condition

624. Food products are kept in cold storage or under refrigeration because

(a) It become very tasty

(b) Can be sued in off season

(c) Food products maintain their freshness, longevity, taste etc. due to least respiration

(d) They remain very cool

625. Which fruit can be stored for long

(a) Sitafal (Custard apple) (b)Banana (c) Papaya (d) Apple

626. While preparing jam, the fruit pulp is put into alum solution. What should be the percentage of it

(a) 0.2% (b) 2% (c) 5% (d) 10%

627. The percentage of acid in preparing jelly is

(a) 0.75 - 1% (b) 1 - 2% (c) 2 - 3% (d) 3 - 4%

628. The material for preparing jelly should be

(a) Pectin (b) Acidic (c) Sugar (d) All of these

629. Pectin is tested by

(a) Refractometer (b) Jellymeter (c) Manometer (d) Potometer

630. Fruits required to prepare jelly are

(a) Fully ripened (b) Unripe (c) Half ripe (d) None of these

631. While preparing mango juice, citric acid or lemon juice is added because

(a) Dirt is removed (b) *pH* value of juice comes down

(c) Juice is kept safe for many days (d) Juice develops sour taste

632. Who proved first that food gets spoiled by micro-organisms

(a) Flemming (b) Hooker (c) Louis Pasteur (d) None of these

633. For waxing of fruits and eggs, which is generally used

(a) Gum (b) Latex (c) Paraffin wax (d) Sugarcane wax

634. Ultraviolet radiations used in food preservation are

(a) Microbistatic (b) Microbicidal (c) Aseptic (d) None of these

635. Which chemical is not used in food preservation

(a) Benzoic acid (b) Salicylic acid

(c) Sodium metabisulphate (d) Ammonium nitrate

636. At very low temperature, plants do not grow. This is due to

(a) Dessication of plants (b)Solarization of plants

(c)Cell cannot grow (d)Cell wall will be inhibited

637. Cryopreservation is done at temperature

(a) $-140°C$ (b) $-120°C$ (c) $-196°C$ (d) $-270°C$

638. Nairization is

(a) Lactic acid fermentation (b) Vinegar fermentation

(c) Use of sugar as preservative (d) Alcoholic fermentation

639. Which food is spoiled very fast?

(a) Semiperishable food (b) Perishable food

(c) Non-perishable food (d) None of these

640. Food can be preserved by

(a) Low temperature (b) High temperature (c) Osmotic pressure (d) All the these

641. Food can be easily preserved at low temperature because at low temperature

(a) The food can easily be digested (b) The food can easily be cooked

(c) The bacterial attack on food is minimise (d) All of the above

TEMPORARY PRESERVATION

Basic Level

642. Use of mild antiseptics for temporary preservation is achieved by

(a) Vinegar (b) Salt (c) Sugar (d) All of these

643. Temporary preservation is performed by

(a) Exclusion of air (b) Pasteurization (c) Waxing (d) All of these

644. Which one is not a method of temporary preservation

(a) Use of mild antiseptics (b) Use of antibiotics

(c) Exclusion of moisture (d) Low temperature treatment at $4°C$

645. By the use of which substance temporary as well as permanent type of preservation can be achieved

(a) Salt, oil and sugar (b) Heat sterilization and sun drying

(c) Dehydration and heat processing (d) Use of low temperature and pasteurization

646. The process of heating milk between $60°C$ to $80°C$ is called

(a) Nairization (b) Asepsis (c) Pasteurization (d) None of these

647. Heating milk or any other liquid at 65°*C* and then sudden cooling is known as

(a) Sterilization (b) Pasteurization (c) Preservation (d) Fermentation

648. Pasteurization make the food free from

(a) All vegetative forms of bacteria (b) Vegetative forms of all pathogenic microbes

(c) All living organisms (d) All bacteria

649. At which temperature canning of high acid foods takes place

(a) 100°*C* (b) 121°*C* (c) 145°*C* (d) 98°*C*

650. For canning of low acid foods, temperature will be

(a) 150°*C* (b) 121°*C* (c) 190°*C* (d) 100°*C*

651. In canned fruits, the nutritive elements are

(a) Safe (b) Unsafe (c) Abnormal (d) Both (b) and (c)

652. Pasteurized milk is

(a) Free from pathogenic bacteria (b)Not free from bacteria

(c) Sterile and will not turn sour under any condition (d)None of these

653. In holding method of pasteurization

(a) After keeping the food material at a temperature of 89.4°*C*, it is immediately cooled

(b) After keeping the food material at 67.2°*C* temperature for 30 minutes, it is cooled

(c) Food material is kept at 0°*C*

(d) Food material is dried in sun

654. Nicholas Apart discovered a method for food preservation which is called as

(a) Pasteurization (b) Fermentation (c) Aseption (d) Canning

655. Pasteurization makes foodstuffs free from

(a) All vegetative forms of bacteria (b) Vegetative forms of all pathogenic microbes

(c) All living organisms (d) All bacteria

656. In pasteurization, milk in boiled for

(a) 60 minutes at 90°*C* (b) 30 minutes at 50°*C* (c) 30 minutes at 65°*C* (d) 60 minutes at 100°*C*

657. After canning, the containers are kept at

(a) 10°*C* temperature (b) 20°*C* temperature (c) 30°*C* temperature (d) 40°*C* temperature

658. Which technique is used to export sea-fishes and prawns

(a) Freezing (b) Canning (c) Irradication (d) Drying

659. In canning process, edible material is heated at

(a) 110°*F* to 250°*F* (b) 270°*F* to 350°*F* (c) 350°*F* to 370°*F* (d) 380°*F* to 400°*F*

PERMANENT PRESERVATION

Basic Level

660. Permanent type of food preservation is done by

(a) Heat sterilization (b) Low temperature treatment below – 9°*C*

(c) By radiation (d) All of these

661. Which one of the following is not used for permanent type of food preservation

(a) Sun drying (b) Fermentation (c) Pasteurization (d) Use of antibiotics

662. In most of the acidic fruits, sterilization process is to boil them at a temperature of

(a) 375°*F* (b) 250°*F* (c) 350°*F* (d) 312°*F*

663. In permanent preservation, sugar solution is used

(a) 15% (b) 30% (c) 45% (d) 60%

664. Permanent preservation by heat sterilization is achieved at temperature

(a) 60 to 80°*C* (b) 80 to 100°*C* (c) 100 to 150°*C* (d) Above 200°*C*

665. Sun drying technique is concerned with

(a) Non-heat application of permanent preservation

(b)Heat application type permanent preservation

(c) Exclusion of moisture method of temporary preservation (d) None of these

666. Fruits, meats, milk etc. are dried for preservation at room temperature by the process of

(a) Dehydration (b) Pasteurization (c) Freezing (d) Vernalization

667. All living organisms are killed by heat treatment known as

(a) Pasteurization (b) Immunity (c) Sterilization (d) None of these

668. Sterilization is done with the help of

(a) Autoclave (b) Rancidity (c) Toxins (d) Vaccination

669. Salt solution used for permanent preservation is

(a) 2% (b) 5% (c) 8% (d) 15%

670. Bacteria can be destroyed by

(a) Dehydration (b) Fermentation (c) Oxidation (d) Sterilization

671. Radiations used in preservation of food are

(a) α and β -rays (b) Ultraviolet rays (c) *X*-rays (d) Both (a) and (b)

PLANT BREEDING

INTRODUCTION

Basic Level

672. Plant breeding is a technique of improving

(a) Agricultural crops (b) Fodder crops (c) Fruit varieties (d) All the above

673. Aims of plant breeding are to produce

(a) Disease-free varieties (b)High yielding varieties

(c) Early maturing varieties (d) All of the above

674. The basis of green revolution is

(a) Extensive cultivation (b)Plant breeding

(c) Sowing at right time (d) Cultivation in black soil

675. Modern plant breeding started in

(a) 1850 (b) 1880 (c) 1900 (d) 1930

676. Plant breeding is

(a) An art (b) A science (c) Both (a) and (b) (d) None of the above

677. The main aim of plant breeding is

(a) To produce improved varieties (b) To make soil fertile

(c) To control pollution (d) To become more progressive

678. In India, earliest work in the field of plant breeding was initiated by

(a) Rao (b) Barber (c) Borlouge (d) Vavilov

679. Credit for bringing green revolution to India goes to

(a) B.P. Pal (b) Norman Borlang (c) M.S. Swaminathan (d) K.C. Mehta

680. Apart from high yield, other main objective of plant breeding is

(a) Improvement of quality (b) Development of resistance

(c) Establishment of change in duration (d) All the above

681. Crop cultivation was first started in

(a) Nile river valley (b) Chinese river valley

(c) Northern plains of India (d) All of the above

682. A man made allopolyploid cereal crop is

(a) *Hordeum vulgare* (b) *Raphano brassica* (c) *Triticale* (d) *Zea mays*

683. Plant breeding has close relationship with

(a) Genetics (b) Cytology (c) Biometry (d) Both (a) and (b)

684. The dwarf varieties of wheat brought from Mexico into India were

(a) Sonara–64 and Sonalika (b) Sonara–64 and Lerma Roja–64

(c) Sharbati sonara and Pusa Lerma (d) Sonalika

685. Which cultivation method is most popular in Madhya Pradesh to cultivate rice

(a) Intensive (b) Dry (c) Wet (d) Tillage

686. The three top-most major crops of the world in order of total production are

(a) Rice> Maize> Wheat (b) Wheat > Rice > Maize

(c) Rice > Wheat > Maize (d) Wheat > Maize > Rice

687. *G. hirsutum* is

(a) Old world diploid (b) Old world tetraploid

(c) New world diploid (d) New world tetraploid

688. The *Triticum aestivum* wheat is

(a) Haploid (7 chromosome) (b) Diploid (14 chromosome)

(c) Tetraploid (30 chromosome) (d) Hexaploid (42 chromosome)

689. Which one of the following is an improved variety of maize

(a) N.P. 710 (b) Co. 4 (c) Jawahar (d) S. 405

690. *Sonara*–64 and *Lerma roja* are varieties of

(a) Wheat (b) Rice (c) Pea (d) Maize

691. The best way to increase the yield of wheat in India is

(a) To sow seeds of improved varieties (b) To use tractors to till the soil

(c) To reduce the quantity of ration consumers (d) To remove weeds from wheat fields

692. Which one is an improved variety of wheat

(a) A. 77 (b) Sonalika (c) Chandramukhi (d) Kuber

693. The latest trend in plant disease control is

(a) Chemical control (b) Biological control

(c) Use of fertilizers (d) Use of disease resistant varieties

694. Man made cereal is

(a) *Triticum* (b) *Triticale* (c) *Pisum* (d) Sugarcane

695. Triticale is the hybrid between wheat and

(a) Maize (b) Barley (c) Rye (d) Bean

696. Dwarf wheats were developed by

(a) Vavilov (b) Borlaug (c) Swaminathan (d) None of these

697. In bread wheat chromosome number is

(a) 42 (6 × 7) (b) 14 (2 × 7) (c) 24 (4 × 6) (d) 21 (7 × 3)

698. Who coined the term '*heterosis*'

(a) Shull (b) Huxley (c) Robard (d) Tansley

699. The famous cultivated plant which developed in China is

(a) Orange (b) Tea (c) Coffee (d) Cotton

700. Greatest genetic diversity of plants is found in

(a) Central America (b) Homelands (c) South America (d) India

701. The change occurring in organisms which only reproduce vegetatively is
(a) Genetic (b) Morphological
(c) Both genetic and morphological (d) Neither genetic nor morphological

702. Agriculture was originated in mesolithic age about
(a) 3000 years ago (b) 5000-10000 years ago
(c) 7000-13000 years ago (d) 20000-25000 years ago

703. Which of the following condition is hybrid breakdown
(a) Failure of hybrid adult to produce functional gametes
(b) Failure of the fusion of ova and sperm plant breed of two species
(c) Failure of hybrid zygote to develop into an offspring
(d) None of these

704. A recalcitrant seed can
(a) Bear dehydration but not low temperature
(b) Not bear dehydration but can tolerate low temperature
(c) Not bear dehydration and cooling below 0°C (d) None of these

705. Genetic diversity means
(a) Intergeneric variations (b)Intraspecific variations
(c) Interspecific variations (d)Both (b) and (c)

706. The origin of sunflower is believed to be in
(a) Peruvian Andes (b) Mexico and Central America
(c) Brazil (d) USA

707. Maize evolved in
(a) USA (b) Brazil
(c) Mexico and Central America (d) Peruvian Andes

708. South-east Asia is thought to be the centre of origin of
(a) Rice, sugarcane, mango and banana (b) Rice, sugarcane and mango
(c) Rice and sugarcane (d) None of these

709. The native place of *Hevea* rubber is
(a) South-east Asia (b) Brazil (c) Peruvian Andes (d) Malaysia

710. Which of the following crops originated in Peru and Brazil but is now mainly grown in India
(a) Maize (b) Potato (c) Groundnut (d) None of these

711. Name the crop which had its birth place in Tropical America but now the centre of production is Mid–west USA
(a) Maize (b) Cocoa (c) Pineapple (d) Oil palm

712. The centre of origin of wheat is
(a) South–east Asia (b) South–west Asia
(c) Asia Minor and Afganistan (d) None of these

713. Potato and tomato are native of
(a) Canada (b) North America (c) China (d) South America

714. Ethiopia is the native place of
(a) Cabbage (b) Rice (c) Coffee (d) Maize

715. The centre of origin of almond and apple is
(a) Asia Minor and Afganistan (b) Peruvian Andes
(c) Brazil (d) Mexico

716. Vavilov's centres of origin of crop plants are located in
(a) Mountains of tropical areas (b)Mountains of temperate areas
(c) Mountains of both tropical and temperate areas (d)Plains of tropical areas

METHODS AND APPLICATION OF PLANT BREEDING

Basic Level

717. A plant breeder wants to develop a disease resistant variety, what he should do first
(a) Hybridization (b) Selection (c) Production of crop (d) Mutation

718. The term "*pureline selection*" was first time proposed by
(a) W. L. Johannsen (b) Sinnot and Dunn (c) Darlington (d) Mather

719. In which crops is the method of mass selection applied
(a) Cross-pollinated (b) Self-pollinated
(c) Both self and cross-pollinated (d) Potato and sugarcane

720. Which is the oldest breeding method
(a) Hybridization (b) Selection (c) Mutation breeding (d) Introduction

721. The hybrids are generally found to be superior to their parents, it is because of
(a) Homozygosity (b) Hybrid vigour
(c) Parents are generally weak (d) None of the above

722. Crosses between, the plants of the same variety are called
(a) Interspecific (b) Intervarietal (c) Intravarietal (d) Intergeneric

723. The offspring from a cross between two individuals differing in at least one set of characters is called
(a) Polyploid (b) Hybrid (c) Mutant (d) Variant

724. The product of hybridization is known as
(a) Clone (b) Homozygous (c) Hybrid (d) Heterozygous

725. Plants having similar genotypes produced plant breeding are called
(a) Clone (b) Haploid (c) Autopolyploid (d) Genome

726. Bombay green banana cultivation is the result of
(a) Mass selection (b) Pureline selection (c) Clonal selection (d) Natural selection

727. Plants can be disease resistant by
(a) Breeding with their wild relatives (b) Colchicine treatment
(c) Hormone treatment (d) Heat treatment

728. As a general rule, inbreeding is possible between

(a) Any two members of a order (b)Any two members of a family

(c) Any two members of a genus (d)Any two members of a species

729. One of the popular method employed in the production of new varieties of plants is

(a) Selection and vegetative propagation (b) Chemical treatment and selection

(c) Exposure to radiation and selection (d) Selection and hybridization

730. The process of removing stamens from the flower bud during hybridization is called

(a) Crossing (b) Selfing (c) Emasculation (d) Caping

731. Desired improved variety of economically useful crops are raised by

(a) Natural selection (b) Hybridization (c) Mutation (d) Biofertilizer

732. Which part of plant breeding is an art

(a) Technique in hybridization (b) Clonal selection

(c) Pureline selection (d) Acclimatization

733. Removal of anthers from flower buds is called **[**

(a) Bagging (b) Hybridization (c) Emasculation (d) Heterosis

734. Synonym of pureline selection is

(a) Progeny selection (b) Pedigree selection (c) Single line selection (d) All the above

735. Increased vigour of a hybrid, over the parents resulting from the crossing of genetically unlike organisms is called

(a) Heterosis (b) Mutant (c) Polyploid (d) None of the above

736. Which one of the following methods is commonly used to maintain the genetic traits of a given plant

(a) By propagating through seed germination

(b) By propagating through vegetative multipli_cation

(c) By generating hybrids through intergeneric pollination

(d) By treating the seeds with gamma radiation

737. Varieties developed by pureline method are

(a) Homozygous and not uniform (b)Homozygous and uniform

(c) Heterozygous and not uniform (d)Heterozygous and uniform

738. Regarding pureline selection which statement is most correct

(a) It is always practiced in self pollinated crops (b) In it large number of plants are selected

(c) In it about 6 years time is taken for the production of a variety

(d) All the above

739. What is the advantage of clonal selection

(a) Varieties developed are stable and easy to (b) Hybrid vigour is easily utilized

(c) Only method to improve clonal crops (d) All the above

740. Regarding mass selection which statement is most suitable

(a) As old as agriculture itself (b) Followed by all farmers every year

(c) Usually practiced in cross pollinated crops (d) All the above

741. The reason for vegetatively reproducing crop plants to suit for maintaining hybrid vigour is that

(a) They can be easily propagated (b) They have a longer life span

(c) They are more resistant to diseases

(d) Once a desire hybrid produced, no changes of losing it

742. What is a clone

(a) A heterozygote produced by sexual means (b) A homozygote produced by asexual means

(c) A heterozygote produced by asexual means (d) A homozygote produced by sexual means

743. Hybrid vigour is mostly due to

(a) Heterozygosity

(b) Superiority of all the genes

(c) Homozygosity of pure characters

(d) Mixing up of cytoplasm of the male with that of female exclusively

744. Heterosis means

(a) Hybrid vigour (b) Hybrids are weak

(c) Hybrids are weak as well as vigorous (d) Hybrids are neither weak nor vigorous

745. Production of plant without fertilization is done by

(a) Vegetative propagation (b)Transplantation (c) Grafting (d) None of these

746. Emasculation is a part of

(a) Clonal selection (b) Mass selection (c) Hybridization (d) Pure line selection

747. Clonal selection technique is not useful for

(a) Sugarcane (b) Wheat (c) Potato (d) Onion

748. Selection is the method of

(a) Plant physiology (b) Plant breeding (c) Genetics (d) Cytology

749. A combination between an open pollinated variety and inbreed line is called

(a) Double cross (b) Top cross (c) Synthetic cross (d) None of the above

750. The process of mating of individuals, which are more closely related than the average of the population to which they belong, is called

(a)Inbreeding (b) Hybridization (c) Heterosis (d) Self breeding

751. Technique employed in plant hybridization

(a) Emasculation (b) Bagging (c) Crossing (d) All the above

752. Pure line breed refers to

(a) Heterozygosity only (b) Homozygosity only

(c) Heterozygosity and linkage (d) Homozygosity and self-assortment

753. Process of hybridization is difficult because of

(a) Susceptibility to mutations (b) Incompatibility and sterility

(c) Selection of suitable parents and hybrids (d) All the above

754. Four inbreed lines of maize are crossed. The cross is

(a) Tetraploid cross (b) Double cross (c) Dihybrid cross (d) Tetrahybrid cross

755. IR–36 was developed through breeding

(a) Six rice varieties and *Oryza nivara* (b) 13 rice varieties and *Oryza nivara*

(c) *Oryza indica* and *Oryza nivara* (d) *Oryza indica* and *Oryza sativa*

756. In crop improvement programme haploids are of great importance because they

(a) Are useful in studies on meiosis

(b) Require only about half the amount of chemical fertilizers as compare to diploids

(c) Give homozygous lines following diploidization

(d) Grow better under adverse conditions

757. The *indica* varieties of rice is crossed with *japonic* varieties as these are

(a) High yielding (b) Resistant to diseases

(c) Cheaper (d) Short life-cycled annual

758. In high yielding `hybrid crop varieties', to exploit hybrid vigour, the farmers need to purchase fresh hybrid seed every year, because

(a) They are not allowed to grow their own seed

(b) The hybrid vigour is lost due to inbreeding depression

(c) The government of India has accepted Dunkel's proposals

(d) It is cheaper to purchase fresh seed

759. Majority of the high yielding varieties of 'Indian rice' have been developed by cross between

(a) *O. sativa japonica* × *O. sativa indica* (b) *O. sativa indica* × *O. nivara*

(c) *O. nivara* × *O. sativa japonica* (d) *O. nivara* × *O. rufipogon*

760. Improved Indian variety of wheat, carrying genes of dwarfness and higher percentage of protein and lysine is

(a) Lerma safed (b) Kalyan (c) Sharbati sonara (d) Sonalika

761. Due to which of the following organism, yield of rice is increased

(a) *Anabena* (b) *Bacillus popilliae* (c) *Sesbania* (d) *Bacillus polymena*

762. Which of the following is not used for crop improvement

(a) Inbreeding (b) Introduction (c) Hybridization (d) Mutations

763. Wheat used in making 'chapati' is

(a) *Triticum aestivum* (b) *Triticale* (c) All species of *Triticum* (d)*Secale*

764. Potato varieties produced for crops are

(a) Haploid (*n*) (b) Diploid (2*n*) (c) Triploid (3*n*) (d) Tetraploid (4*n*)

765. For the formation of diploid cells from haploid cells, colchicine is used to
(a) Stop the spindle fibres formation (b) Replicate DNA twicely in one cell cycle
(c) Stop the formation of centromere (d) Stop the mitotic division

766. Which of the following effect is produced by colchicine
(a) Duplication of DNA (b) Duplication of chromosomes
(c) Formation of spindle fibres (d) Hinderance in the formation of middle wall

767. In polyploid breeding, number of chromosome set
(a) Increases (b) Decreases
(c) There is no effect on the number of chromosome sets
(d) None of the above

768. A change in the chromosome number is called
(a) Chromosomal mutation (b)Gene mutation (c) Somatic mutation (d) Polyploidy

769. A material which arrests cell division is obtained from
(a) *Colchicum* (b) *Crocus* (c) *Chrysanthemum* (d) *Dalbergia*

770. Which one of the following chemical induces polyploidy in plant cells
(a) 2, 4– dichlorophenoxy acetic acid (b) Rifampicin
(c) Cytokinenine (d) Colchicine

771. The alkaloid from *Colchicum autumnale* of Liliaceae induces
(a) Sterility (b) Dormancy (c) Cell division (d) Polyploidy

772. Which of the following is most effective chemical mutagen
(a) Methane (b) Guanine (c) Carbon tetrasulphide (d)Caffeine

773. Who used X-rays for the production of mutations
(a) Muller (b) Leeuwenhoek (c) Recawsky (d) Hooker

774. Hereditary variations in plants have been produced by the use of
(a) X-rays (b) Gibberellic acid (c) D.D.T. (d) Auxins

775. Mutations caused by mutagenic agents are termed as
(a) Spontaneous mutations (b)Chemical mutations
(c)Induced mutations (d) Chromosomal mutations

776. Mutations are caused due to
(a) Radioactive mutagens (b)Chemical mutagens
(c)Radiation mutagens (d) Change in base sequence

777. Which one of the following agents is used to induce mutation in higher plants
(a) Red light (b) Gamma rays (c) Streptomycin (d) Dichloromethyl area

778. What are micro–mutations
(a) Union of chromosomes (b)Reduction of chromosomes
(c) Changes in genes (d) Polyploidy

779. An orthodox seed can
(a) Tolerate dehydration and freezing (b) Tolerate dehydration but not freezing
(c) Tolerate freezing but not dehydration (d) None of these

BIOTECHNOLOGY

INTRODUCTION

Basic Level

780. Use of living organisms or their substances in industrial processes is called
(a) Microbiology (b) Biotechnology
(c) Industrial engineering (d) Genetic engineering

781. The International Centre for Genetic Engineering and Biotechnology established by the United Nations Organization (UNO) is located at
(a) New Delhi (b) Paris (c) Tokyo (d) Washington

782. In India, first time an international meeting on biotechnology was held in
(a) 1986 (b) 1987 (c) 1988 (d) 1989

783. Which of the following is used in biotechnology
(a) Cattle (b) Yeast
(c) Both cattle and yeast (d) Neither cattle nor yeast

784. Lal Bahadur Shastri biotechnological centre is in
(a) Bombay (b) Calcutta (c) Delhi (d) Kanpur

785. First time in the history of biotechnology, when plasmids were successfully used as *vectors*
(a) 1965 (b) 1968 (c) 1971 (d) 1973

786. When and where first time word "biotechnology" was used
(a) In 1950 in England (b) In 1960 in Holand (c) In 1920 in U.N. (d) In 1910 in Germany

787. Biotechnology is the modern branch of biology which deals with
(a) Genetic engineering (b) Biochemistry (c) Microbiology (d) All the above

788. Immobilised enzymes are generally used for bioreactors in
(a) Batch process (b) Digestive process (c) Activation process (d) Continuous process

789. The enzyme diastase was identified by
(a) S.A. Waksman (b) A. Fleming (c) Christian Hasen (d) Payen and Persoz

790. Sex hormone is a
(a) Fat (b) Protein (c) Carbohydrate (d) Steroid

791. Vaccine for small pox was developed by
(a) Cesor Milstein (b) Louis Pasteur (c) Edward Jenner (d) Salman Waksman

792. Who first realized the use of yeast in fermentation
(a) Christian Hansen (b) Louis Pasteur (c) A. Spike (d) D.A. Jackson

793. Interferons are
(a) Antiviral proteins (b) Complex proteins
(c) Anti-bacterial proteins (d) Anti-cancer proteins

794. Utility of fungi for steroid conversion was demonstrated by
(a) Pasteur and Jaubert (b) Kohler and Milstein
(c) Murray and Peterson (d) Waksman and Woodruff

795. Rennet enzyme was purified by
(a) A. Flemming (b) S.A. Waksman (c) Payen and Persoz (d) Christian Hansen

796. Offsite collections are part of
(a) *In situ* conservation (b) *Ex situ* conservation
(c) Both *in situ* and *ex situ* conservation (d) None of these

797. Tissue plasminogen activator is
(a) An enzyme (b)A vitamin
(c) An electric device (d)A chemical that stimulates tissue differentiation

GENETIC ENGINEERING

Basic Level

798. Which of the following is required in genetic engineering
(a) DNA polymerase (b) RNA polymerase (c) Plasmid (d) Ribosome

799. Which of the following is important in genetic engineering
(a) DNA polymerase (b) Restriction endonuclease
(c) RNA polymerase (d) Nuclease

800. Modified antibiotics are manufactured by the technique of
(a) Ultrafiltration (b) Ultracentrifuge (c) Vernalization (d) Genetic engineering

801. Which one of the following is regarded as a natural genetic engineer
(a) *Klebsiella frosteri* (b) *Bacillus subtilis*
(c) *Agrobacterium tumefaciens* (d) *Neurospora*

802. Which of the following is related to genetic engineering
(a) Plastid (b) Plasmid (c) Heterosis (d) Mutation

803. Which one of the following is indispensable in genetic engineering
(a) DNA ligase (b) DNA polymerase
(c) RNA polymerase (d) Reverse transcription

804. Insertion or deletion of one or more new genes which are absent in an organism by artificial method (not by reproduction) is called as
(a) Molecular biology (b) Genetic hybridization (c) Cellular genetics (d) Genetic engineering

805. When first time extra DNA fragment was inoculated by plasmid into *E. coli*
(a) 1966 (b) 1970 (c) 1973 (d) 1976

806. Plants are genetically engineered with novel genes by
(a) Protoplast fusion (b) Recombinant DNA technology
(c) Embryo rescue technique (d) Recombination breeding

807. The enzyme restriction endonuclease
(a) Cuts RNA strand (b) Cuts double strand of DNA
(c) Joins the strands of DNA (d) Cuts single strand of DNA

808. Introduction of foreign genes for improving genotype is
(a) Biotechnology (b) Tissue culture (c) Vernalization (d) Genetic engineering

809. Manipulation of DNA in genetic engineering became possible due to the discovery of
(a) Primase (b) Transcriptase
(c) DNA ligase (d) Restriction endonuclease

810. The technique involving insertion of a desired gene into the DNA of plasmid vector is known as
(a) Dressing (b) Splicing (c) Cloning (d) Drafting

811. On the basis of function, which of the following is known as bioscissors
(a) Endonucleases (b) Hydrolases (c) Esterases (d) DNA polymerases

812. DNA probes are used in human for
(a) Disease diagnosis (b) Disease control (c) Disease resistance (d) Disease tolerance

813. 'Cloning' is meant for
(a) Production of *HGH* gene in *E. coli* (b) To preserve the genotype of organism
(c) To replace the original gene (d) All of these

814. "Molecular scissors" used in genetic engineering is
(a) Helicase (b) DNA ligase (c) DNA polymerase (d) Restriction endonuclease

815. Which one of the following is called resistance transfer factor
(a) *F*–factor (b) *R*–factor (c) *Col*–factor (d) None of these

816. Which of the following is more suitable place for germplasm collection
(a) Peru (b) France (c) Britain (d) Brazil

817. DNA recombinent technique can be
(a) Harmful (b) Useful
(c) Both, harmful and useful (d) Neither harmful nor useful

818. It is now possible to breed plants and animals with desired characters through
(a) Genetic engineering (b) Chromosome engineering
(c) Ikebana technique (d) Tissue culture

819. Nucleic acid segment which is used to find the position of a gene and it forms a hybrid with this gene would be
(a) Retrovirus (b) Probe (c) Vector (d) Clone

820. Genetic engineering is possible, because
(a) The phenomenon of transduction in bacteria is well understood
(b) We can see DNA by electron microscope
(c) We can cut DNA at specific sites by endonucleases like DNAase–I
(d) Restriction endonucleases purified from bacteria can be used in *vitro*

821. Which enzyme is used for the separation of genetic material

(a) Ligase (b) Restriction endonuclease

(c) Hydrolase (d) Amylase

822. Restriction enzyme was discovered by

(a) Berg (b) Smith and North (c) Waksman (d) Alexander Fleming

823. Two bacteria found to be very useful in genetic engineering experiment are

(a) *Nitrosomonas* and *Klebsiella* (b) *Escherichia* and *Agrobacterium*

(c) *Nitrobacter* and *Azotobacter* (d) *Rhizobium* and *Diplococcus*

824. Genetically engineered bacteria are used in the commercial production of

(a) Thyroxin (b) Testosteron (c) Human insulin (d) Melatonin

825. Which one of the following is a first genetic engineered medicine

(a) Humilin (b) Somatostatin

(c) Interferon (d) Human growth hormone

826. Zinder and Laderburg showed the process of transduction in which one of the following bacteria

(a) *Salmonella typhimurium* (b) *E. coli*

(c) *Diplococcus pneumoniae* (d) *Shigella*

827. Southern blot technique is

(a) DNA profiling (b) Widal test (c) ELISA test (d) Blood test

828. Which one is used as vector in genetic engineering

(a) Cyanophage (b) Bacteriophage (c) Plasmid (d) None of the above

829. Which of the following is a genetic vector

(a) Plasmid (b) Phage (c) Cosmid (d) All of these

830. Which of the following is related to genetic engineering

(a) Plastid (b) Plasmid (c) Heterosis (d) Mutation

831. How many operons are present in the *nif* part of DNA of *Klebsiella*

(a) Three (b) Four (c) Six (d) Seven

832. The organism which is used for gene transfer in higher organism is

(a) *Agrobacterium tumefacians* (b) *E. coli*

(c) *Acetobacter* (d) *Bacillus thuringenesis*

833. A human gene product can be produced by genetically engineered bacteria. This is possible because the

(a) Genetic code is universal

(b) Human chromosome can replicate in bacterial cell

(c) Bacterial cell can carry out the splicing reaction

(d) Mechanism of gene regulation is identical in humans and bacteria

834. When two individuals are clones to each other and offspring of their parents, then they are

(a) Asexually produced (b) Sexually produced (c) Siblings (d) Monozygotic twins

835. *Ex situ* conservation is carried out through

(a) Funneling the threatened species into trade (b) Offsite collections

(c) Gene banks (d) All of these

836. Germplasm is contained in

(a) Reproductive cells (b) Somatic cells (c) Both (a) and (b) (d) None of these

837. Plasmids are found in

(a) Bacteriophage (b) Yeast (c) Volvox (d) Bacteria

838. Transgenic plants are

(a) Plants having no gene

(b) Plants in which gene are present in an opposite or transposition

(c) Plants in which genes have no function to perform

(d) Plants in which genes of another organism have been implanted

839. Improvement of crops by preserving germplasm in frozen state is called

(a) Cryopreservation (b) Cold storage preservation

(c)Vernalization (d) *In situ* preservation

840. Cryopreservation of germplasm is done at

(a) 0°*C* (b) – 50°*C* (c) – 196°*C* (d) –273°*C*

841. *In situ* conservation is carried out through

(a) Biosphere reserves (b) National parks (c) Wildlife sanctuaries (d) All of these

842. Which enzyme joins DNA fragment

(a) DNA Ligase (b) DNA Polymerase (c) DNA Gyrase (d) Topoisomerase

APPLICATIONS OF BIOTECHNOLOGY

Basic Level

843. The phenomenon of antibiotic was discovered by

(a) Fleming (b) Pasteur (c) Waksman (d) Babes

844. Which of following is not correct about antibiotics

(a) First antibiotic is discovered by A. Flemming

(b) Term antibiotic was given by Salman Waksman

(c) Some persons are allergic for specific antibiotics

(d) Every antibiotic works against only one type of germ

845. Broad spectrum antibiotic is that which

(a) Acts on both pathogens and hosts (b) Acts on all bacteria and viruses

(c) Acts on a variety of pathogenic micro-organisms

(d) Is effective in very small amounts

846. Most of the *Eubacteriales* antibiotics come from

(a) *Bacillus* (b) *Rhizobium* (c) *Pseudomonas* (d) *Streptococcus*

847. Which of the following antibiotics is found to be most effective against mycoplasma

(a) Penicillin (b) Streptomycin (c) Tetracycline (d) Nystatin

848. Chloramphenicol and erythromycin (broad spectrum antibiotics) are produced by

(a) *Streptomyces* (b) *Nitrobacter* (c) *Rhizobium* (d) *Penicillium*

849. Waksman got Nobel Prize for the discovery of

(a) Chloromycetin (b) Neomycin (c) Streptomycin (d) Penicillin

850. Streptomycin is produced by **or** From which micro-organism streptomycin is prepared

(a) *Streptomyces venezuelae* (b) *Streptomyces griseus*

(c) Streptomyces scoleus (d) Streptomyces fradie

851. Neomycin is extracted from

(a) *Streptomyces griseus* (b)*Streptomyces venezuelae*

(c) *Streptomyces fradiae* (d)*Streptomyces rimosus*

852. Streptomycin was first isolated in 1944–45 by

(a) Leeuwenhoek (b) Burkholder (c) Alexander Fleming (d) Waksman

853. Antibiotics inhibit the growth of or destroy

(a) Bacteria and fungi (b) Bacteria and viruses

(c) Bacteria, algae and viruses (d) Bacteria, fungi and viruses

854. A. Flemming is famous for his discovery of

(a) Penicillin (b) Streptomycin (c) Actinomycin (d) Chloromycetin

855. Most of the micro-organisms which produce antibiotics live in the soil because

(a) Darkness favours synthesis of antibiotics

(b) By the phenomenon of antibiosis, their growth, nutrition and survival value are enhanced in competitive world of microflora of the soil

(c) They cannot get nutrition outside the soil

(d) No one easily misuse their antibiotics

856. Terramycin is obtained from

(a) *Streptomyces venezuelae* (b) *Streptomyces aureofaciens*

(c) *Streptomyces remosus* (d) *Streptomyces griseus*

857. Who coined the term "antibiotics"

(a) Flemming (b) Florey (c) Chain (d) S. Waksman

858. Antibiotic substances are used

(a) In the form of food materials (b)In the form of medicines

(c) In the form of fertilizers (d) None of these

859. Antibiotics are

(a) Herbicides (b) Pesticides (c) Macrobicides (d) Bactericides

860. The fungus *Penicillium notatum* is used to obtain the drug

(a) Penicillin (b) Kanamycin (c) Erythromycin (d) Streptomycin

861. *Streptomyces fradiae* produces

(a) Erythromycin (b) Neomycin (c) Terramycin (d) Aureomycin

862. Penicillin was discovered by

(a) Waksman (b) Dubois (c) Robert Koch (d) A. Fleming

863. Antibiotics are mostly obtained from

(a) Fungi (b) Actinomycetes (c) Cyanobacteria (d) Both (a) and (b)

864. Penicillin is obtained from

(a) *Aspergillus fumigatus* (b)*Penicillium chrysogenum*

(c) *Penicillium griseofulvum* (d) *Streptomyces griseus*

865. Sir Alexander Fleming extracted penicillin from

(a) *Penicillium citrinum* (b) *Penicillium notatum*

(c) *Penicillium chrysogenum* (d) *Bacillus brevis*

866. Antibiotics are produced by

(a) Mucor (b) Penicillium (c) Agaricus (d) All of these

867. Woodruf (1941) were responsible for the isolation of

(a) Neomycin (b) Actinomycin (c) Penicillin (d) Streptomycin

868. Which of the following is an antifungal antibiotics

(a) Penicillin (b) Cephalosporin (c) Griseofulvin (d) Chloramphenicol

869. Antibiotic flavicin is obtained from

(a) *Aspergillus flavus* (b) *Aspergillus clavatus*

(c) *Streptomyces griesus* (d) *Streptomyces fradiae*

870. Which of the following is not an antibiotic

(a) Griseofulvin (b) Cephalosporin (c) Citric acid (d) Streptomycin

871. Chloromycetin is produced by

(a) *Bordetella pertusis* (b) *Streptomyces venezuelae*

(c) *Streptomyces rumosus* (d) *Clostridium botulinum*

872. Streptomycin is used to cure the diseases caused by the bacteria

(a) Gram-positive (b) Gram-negative

(c) Gram-neutral (d) Both gram-positive and gram-negative

873. A compound which is produced by an organism and inhibits the growth of other organisms is called

(a)Antigen (b) Antibody (c) Antibiotic (d) Antiallergic

874. The prerequisites for biotechnological production of antibiotics is

(a) To search an antibiotic producing microorganism (b)To isolate the antibiotic gene

(c) To join antibiotic gene with *E. coli* plasmid (d)All of the above

875. The antibiotic "chlorellin" is extracted from the genus

(a) *Chlamydomonas* (b) *Chlorella* (c) *Spirogyra* (d) *Batrachospermum*

876. The drug streptomycin inhibits the process of

(a) Procaryotic translation (b)Eucaryotic translation

(c) Procaryotic transcription (d) Eucaryotic transcription

877. First antibiotic isolated was

(a) Terramycin (b) Neomycin (c) Penicillin (d) Streptomycin

878. Which one of the following is used in the baking of bread

(a) *Rhizopus stolonifer* (b) *Zygosaccharomyces octosporous*

(c) *Saccharomyces cerevisiae* (d) *Saccharomycodes ludwigii*

879. Which one of the following is used in the production of alcohol

(a) *Leuconostoc citrovorum* (b) *Saccharomyces cerevisiae*

(c) *Torulopsis utilis* (d) *Clostridium botulinum*

880. *Saccharomyces cervisiae* is

(a) Akaryote (b) Prokaryote (c) Sugars (d) Proteins

881. The fruit juices turn bitter in taste if they are kept in open place for some time, because of

(a) Bacteria of the atmosphere react with the juice (b) Fermentation of the juice by yeast

(c) Some internal factors (d) All the above three statements are correct

882. The micro-organism grown on molasses and sold as a food flavouring substance is

(a) *Sacchromycetes* (b) *Rhizopus* (c) *Acetobacter* (d) *Lactobacillus*

883. Which of the molecules listed below is a product of fermentation of glucose by yeast

(a) $(C_6H_{10}O_5)n$ (b) C_2H_5OH (c) $C_6H_{12}O_6$ (d) CH_3OH

884. Yeast is an important source of

(a) Vitamin C (b) Riboflavin (c) Sugars (d) Proteins

885. Vinegar is produced from sugars with the help of

(a) *Lactobacillus* (b) *Acetobacter* (c) *Nitrosomonas* (d) *Salmonella*

886. Wine is prepared by fermentation of grape juice by

(a) *Bacillus liquifaciens* (b) *Penicillium roqueforti*

(c) *Saccharomyces cerevisiae* (d) Streptococcus aureus

887. Which micro-organism is used in the formation of cheese

(a) *Streptococcus* (b) *Aspergillus* (c) Acetic acid bacteria (d) Lactic acid bacteria

888. The process which the yeast cells perform is called

(a) Transpiration (b) Pastuerization (c) Fermentation (d) Effervescence

889. Citric acid is produced by

(a) *Aspergillus niger* (b) *Streptococcus lactic*

(c) *Acetobacter suboxydans* (d) *Candida utilis*

890. Yeast in an important source of

(a) Vitamin *C* (b) Vitamin *B* (c) Vitamin *A* (d) Vitamin *D*

891. Which one of the following is used in the manufacture of alcohol

(a) Bacteria (b) Water molds (c) Yeasts (d) Slime molds

892. Beer is obtained by the fermentation of seeds of
(a) *Hordeum vulgare* (b) Rice (c) Maize (d) All the above

893. The new strain of bacteria produced by biotechnology in alcohol industry is
(a) *Escherichia coli* (b) *Saccharomyces cerevisiae*
(c) *Bacillus subtilis* (d) *Pseudomonas putida*

894. The organism used for alcohol fermentation is
(a) *Penicillium* (b) *Pseudomonas* (c) *Aspergillus* (d) *Saccharomyces*

895. Germinating barley seeds are employed in the preparation of
(a) Cheese (b) Wine (c) Beer (d) Lactic acid

896. Conversion of sugar into alcohol during fermentation is due to the direct action of
(a) Temperature (b) Micro-organisms
(c) Concentration of sugar solution (d) Zymase

897. Yeast is used in the production of
(a) Ethyl alcohol (b) Acetic acid (c) Cheese (d) Curd

898. The bread is soft and porous when the yeast cells are mixed in the lump of wheat flour because
(a) Yeast produce benzoic acid
(b) Evolution of CO_2 makes the bread spongy
(c) Yeast is soft and flour also becomes soft
(d) Yeast produces acetic acid and alcohol which give softness to the bread

899. Which of the following enzyme is secreted by yeast, responsible for fermentation
(a) Enolase (b) Dehydrogenase (c) Zymase (d) Invertase

900. *Tonulopsis utilis* is
(a) A food yeast (b) Employed for synthesis of citric acid
(c) An important intestinal commensal
(d) Micro-organism that yields third generation vaccines

901. Alcoholic beverages are obtained with the help of
(a) Penicillium (b) Yeast (c) Blue-green algae (d) None of the above

902. Which of the following enzymes are used for converting corn starch into high fructose syrup
(a) Glucoisomerases (b) Glucoamylases (c) Amylases (d) All of these

903. Which one of the following systems commonly used in alcoholic fermentation
(a) Bacterial system (b) Algal system (c) Fungal system (d) Viral system

904. *Ti*–plasmids are present in
(a) *Agrobacterium* (b) *Cymbidium* (c) *Dendrobium* (d) *Syzygium*

905. Dough kept overnight in warm weather becomes soft and spongy because of
(a) Cohesion (b) Osmosis
(c) Absorption of CO_2 from atmosphere (d) Fermentation

906. Anand Chakraborty has used biotechnology for
(a) Production of insulin (b)Removal of oil pollution
(c) Production of interferon(d)Production of relaxin

907. *Trichoderma reesei* is being used for the
(a) Industrial production of cellulase (b) Biological control of plant diseases
(c) Industrial production of antibiotics (d) Industrial production of amylase

908. Which of the following micro-organism is used for production of citric acid in industries
(a) *Lactobacillus bulgaris* (b) *Penicillium citrinum*
(c) *Aspergillus niger* (d) *Rhizopus nigricans*

909. The genetically engineered crop which has been recently introduced in India is
(a) Herbicide tolerant maize (b) Bt cotton
(c) Slow ripening tomato (d) Golden rice

910. Which protein production was successfully introduced in *E. coli*
(a) Interferon (b) Xanthotoxin (c) Somatostatin (d) Relaxin

911. *nif* genes occur in
(a) *Rhizobium* (b) *Penicillium* (c) *Aspergillus* (d) *Streptococcus*

912. Micropropagation technique is commercially used in the growing of
(a) Cotton (b) Banana (c) Mango (d) Rice

913. In the formation of ascorbic acid, the microorganism used is
(a) *Acetobacter* (b) *Streptomyces sp.*
(c) *Bacillus megatherium* (d) *Propioni bacterium*

914. By the use of biotechnology, in which bacteria production of B_2 vitamins has been increased to about 20,000 times
(a) *Ashbya gossypi* (b) *E. coli*
(c) *Pseudomonas denitrificans* (d) *Propionibacterium shermanii*

915. First hormone produced by culturing bacteria is
(a) Insulin (b) Thyroxin (c) Testosteron (d) Adrenaline

916. An antiviral chemical produced by the animal cell is
(a) Virion (b) Interferon (c) Repressor protein (d) Hormone

917. The vaccine of Hepatitis-B is a
(a) First generation vaccine (b)Interferon
(c) Second generation vaccine (d) Third generation vaccine

918. Which of the following organic acids was produced by fermentation
(a) Oxalic acid (b) Lactic acid (c) Citric acid (d) Propionic acid

919. Steroids are used in
(a) Birth control (b) Treatment of hormonal balance
(c) Treatment of auto-immune diseases (d) All of these

920. In which bacteria gene of insulin was cloned
(a) *E. coli* (b) *Clostridium* (c) *Shigella* (d) *Diplococcus*

921. Vitamin B_{12} is produced directly during the course of fermentation by
(a) *Ashbya gossypii* (b) *Rhizopus stolonifer*
(c) *Saccharomyces cerevisiae* (d) Propionibacteria

922. Which one of the following pairs is not correctly matched
(a) Plasmid — Small piece of extrachromosomal DNA in bacteria
(b) Interferon — An enzyme that interferes with DNA replication
(c) Cosmid — A vector for carrying large DNA fragments into host cells
(d) Myeloma — Antibody – producing tumor cells

923. Humulin is
(a) A form of chitin (b) A powerful antibiotic
(c) A new digestive enzyme (d) Human insulin

924. For the manufacture of gluconic acid and citric acid, which of the following micro-organism is used
(a) *Lectobacillus bulgaris* (b)*Acetobacter sp.* (c) *Aspergillus niger* (d) *Gluconobacter sp.*

925. Cheese is prepared from
(a) *Lactobacillus* (b) *Streptococcus*
(c) *Leuconostoc* (d) *Streptococcus* and *Lactobacillus*

926. Sodium chloride is added during preparation of cheese as it
(a) Gives flavour (b) Controls moisture
(c) Hardens cheese (d) Controls moisture and gives flavour

927. Rennin used in cheese industry is
(a) Antibiotic (b) Alkaloid (c) Enzyme (d) Inhibitor

928. Cheese and Youghurt are products of the process
(a) Distillation (b) Pasteurization (c) Fermentation (d) Dehydration

929. In olden days cheese was prepared by
(a) Rennet enzyme (b) *Clostridium* bacteria (c) *Aspergillus* (d) None of these

930. Hybridomas are employed for
(a) Synthesis of antibiotics (b)Killing cancer cells
(c) Synthesis of monoclonal (somaclonal) antibodies
(d) Production of somatic hybrids

931. Raw cheese is known as
(a) Blue cheese (b) Cottage cheese (c) Swiss cheese (d) None of these

932. Curding of milk takes place by
(a) *Streptococcus lactis* (b) *Streptococcus thermophillus*
(c) *Lactobacillus lactis* (d) All the above

933. Genetically engineered human insulin is manufactured by the use of
(a) *Pseudomonas* (b) *Ashbya gossypii* (c) *Rhizopus* (d) *Escherichia coli*

934. Commercial manufacture of **cortisone** is now achieved by

(a) *Aspergillus odraceous* (b)*E. coli*

(c) *Saccharomyces cerevisiae* (d) *Streptococcus aureus*

935. Enzymes can be immobilised by

(a) Cross-linking enzyme molecules (b) Covalently attaching to a solid support

(c) Entrapping them in gel (d) All the above

936. The application of microbial metabolism to transform simple raw materials into valuable products is

(a) Biocatalysis (b) Genetic engineering (c) Tissue culture (d) Fermentation

937. Which of the following is not correctly matched

(a) *Leucaena leucocephala* – Fixes atmospheric nitrogen

(b) *Psophocarpus tetragonolobus* – Seeds are nutritive

(c) *Simmondsia chinesis* – Liquid wax is obtained

(d) *Parthenium argentatum* – Furniture wood is obtained

938. Cells obtained from cancerous tumours are known as

(a) Hybridomas (b) Myelomas (c) Lymphocyte (d) Monoclonal cells

939. Kohler and Milstein developed biotechnology for

(a) Monoclonal antibodies (b)Steroid synthesis

(c) Immobilization of enzymes (d) Myeloma

940. Hybridomas are the result of fusion of

(a) Male reproductive cells (b) Female reproductive cells

(c) Normal antibody producing cells with myeloma

(d) Abnormal antibody producing cells with myeloma

941. Hybridoma cells are

(a) Nervous cells are (b) Hybrid cells resulting from myeloma cells

(c) Only cells having oncogenes (d) Product of spore formation in bacteria

942. Micro-organism used in the production of **youghurt** is

(a) *Salmonella sp.* (b) *Lectobacillus bulgaris*

(c) *Streptococcus thermophillus* (d) Both (b) and (c)

943. Somatostatin is a

(a) Growth hormone (b) An enzyme (c) A steroid (d) A carbohydrate

944. Important objective of biotechnology in agriculture section is

(a) To produce pest resistant varieties of plant (b) To increase the nitrogen content

(c) To decrease the seed number (d) To increase the plant weight

945. Rennet is used in

(a) Fermentation (b) Cheese making

(c) Bread making (d) Synthesis of antibiotic

946. Milk is converted into curd (youghurt) by biological activity of

(a) Algal cells (b) Fungal cells (c) Chloroplasts (d) *Lactobacillus cells*

947. Which of the following participates in the manufacturing of dextrans

(a) *Lactobacillus* (b) *Leuconostoc* (c) *Pseudomonas* (d) *Mucor*

948. Dextran is used in

(a) Bleeding (b) Blood preservation (c) Blood transfusion (d) Blood clotting

949. The enzyme TPA is used to

(a) Maintain turgor pressure (b) Strengthen tissues

(c) Increase plasma (d) Dissolve blood clots

950. Biofertilizer technology in rice cultivation involves the use of

(a) Parasitic fungi (b) Methanogenic bacteria

(c)Diazotrophic cyanobacteria (d) Red algae

951. For rapid production of alcohol, immobilised yeast cells are kept in

(a) Silica gel (b) Wire netting

(c) Porcelain columns (d) Calcium alginate beads

952. Endosulphon is a

(a) Herbicide (b) Weedicide (c) Rodenticide (d) Pesticide

953. The name of drug used in cancer treatment produced by biotechnology is

(a) Interferon (b) HGH (c) TSH (d) Insulin

954. Which of the following established the scientific basis of vaccination

(a) Louis Pasteur (b) Edward Jenner (c) Cesar Milstein (d) George Kohler

955. What is interferon

(a) A type of plasmid (b) A type of protein (c) A type of gene (d) A type of hormone

956. Yoghurt is produced by

(a) *Lactobacillus bulgaricus* (b)*Lactobacillus acidophilus*

(c) *Streptococcus thermophilus*

(d)Both Lactobacillus bulgaricus and *Streptococcus thermophilus*

957. Genetically engineered human insulin is called

(a) Humulin (b) Haematin (c) Hybridoma (d) Hybrid

958. Cheeses are usually classified on the basis of

(a) Texture (b) Flavour (c) Colour (d) All the above

959. Lactic acid is produced by

(a) *Lactobacillus bulgaris* (b) *Streptococcus lactis*

(c) *Rhizopus oryzae* (d) All the above

960. Maximum utilization of the techniques of biotechnology has been made in the field of

(a) Agriculture (b) Medicines (c) Industries (d) Biogas production

961. Hepatitis–B vaccine is a

(a) First generation vaccine (b)Second generation vaccine

(c) Third generation vaccine (d) An interferon

962. Interferons are useful in controlling

(a) TB (b) Cancer (c) Malaria (d) Blood pressure

963. Which one of the following is not used in the production of yoghurt

(a) *Streptococcus lactis* (b) *Streptococcus thermophilus*

(c) *Lactobacillus bulgaricus* (d) *Acetobacter aceti*

964. Exchange of germplasm is carried preferably through shoot tip culture because they are

(a) Genetically stable (b) Small and handy (c) Virus free (d) Cost is very low

965. In somatic hybridization technique, the material generally used is

(a) IAA (b) 2, 4–D (c) Polyethylene glycol (d) Starch

966. The main technique involved in agricultural biotechnology is called

(a) Tissue culture (b) Transformation (c) Plant breeding (d) DNA replication

967. Parasexual hybridization means

(a) Fusion of male gamete with female gamete

(b) Fusion of male gamete with synergid nucleus

(c) Fusion of somatic protoplasts (d) Fusion of male gamete with protoplasts

968. Somatic hybridization of potato and tomato forms

(a) *Triticale* (b) Pomato (c) *Secale* (d) *Altonia*

969. Axenic culture is best defined as

(a) Cell cultures (b)Cell cultures free from micro-organisms

(c) Cell cultures of insectivorous plants (d)Cell cultures free from other micro-organisms

970. When two plants growing in different season and different geographical area, they can produce hybrid by

(a) Pollen culture (b) Tissue culture

(c) Somatic embryogenesis (d) *Invitro* synthesis

971. A plant cell has potential to develop into full plant. This property of the plant cell is called

(a) Tissue culture (b) Totipotency (c) Pleuripotency (d) Gene cloning

972. The method of growing micro-organisms as a thin layer on nutrient medium is known as

(a) Thin layer growth system (b) Support growth system

(c) Suspended growth (d) None of these

973. Piece of sterile plant tissue to be used for tissue culture under aseptic condition is

(a) Inoculant (b) Explant (c) Clone (d) Somaclone

974. In the production of leavened bread, the following is used

(a) *Bacterium* (b) Yeast (c) *Rhizopus* (d) None of the above

975. Growing big trees and plants in small pot is called

(a) Bonsai (b) Pot culture (c) Tree culture (d) Green gardening

976. Cultivation of trees, in a dwarf form, is known as

(a) Ikebana (b) Bonsai (c) Apomixis (d) Arboriculture

977. What does Bt stand for in the popular crop of Bt-cotton

(a) Biotechnology (b) Best type

(c) *Bacillus tomentosa* (d) *Bacillus thuringenesis*

BIOENERGY

Basic Level

978. Energy plantation refers to

(a) Setting up new electricity plants (b)Growth of fuel wood trees

(c) Manufacture of more generators (d)Erection of more dams

979. With the exception of water, which one of the following is possibly the most important accessory chemical substance in industrial processes?

(a) Petroleum (b) Rubber (c) Ethanol (d) Liquid nitrogen

980. Non-conventional energy source is

(a) Tidal energy (b) Biogas (c) Geothermal energy (d) All of these

981. The biomass can be used to

(a) Obtain alcohol (b) Generate biogas

(c) Generate producer gas (d) All of these

982. One of the following aquatic weed has been exploited for biogas production

(a) *Hydrilla* (b) *Ceratophyllum* (c) *Eicchornia* (d) *Vallisneria*

983. Energy source of this earth is

(a) Sunlight (b) Respiration (c) Photosynthesis (d) Mitochondria

984. One of the following is not the petroleum plant

(a) Sugarcane (b) Maize (c) Potato (d) Sunflower

985. The rate of biogas production can be limited by

(a) Methane production (b) Cellulose digestion

(c) Conversion of monomers to organic acids (d) None of these

986. Non-renewable source of energy is

(a) Forest wealth (b) Wild life (c) Hydel power (d) Coal reserves

987. Biogas can be a good substitute for

(a) Fuel wood (b) Petroleum and oil (c) Coal (d) Charcoal

988. One of the following bacterial groups are exploited in biogas production

(a) Methogens (b) Methanotrophs (c) Organotrophs (d) Eubacteria

989. Major autotrophic biomass in oceans is contributed by

(a) Forests (b) Algae and phytoplanktons

(c) Crops (d) None of these

990. One of the following plants have contributed to coal formation

(a) Pteridophytes (b) Gymnosperms (c) Bacteria (d) Archaebacteria

991. The economically friendly measure to conserve solar energy is

(a) Sugarcane plantation (b)Energy plantation (c) (a) and (b) both (d) None of these

992. Desert can be converted into greenland by

(a) Oxylophytes (b) Psammophytes (c) Halophytes (d) Tropical trees

993. The energy generated by hydel power plant is

(a) Renewable and non-polluting (b) Renewable and polluting

(c) Non-renewable and polluting (d) Non-renewable and non-polluting

994. LPG cooking gas is

(a) Low price gas (b) Low pressure gas (c) Biogas (d) Fossil fuel

995. A non-polluting source of energy is

(a) Wood (b) Coal (c) Solar (d) Nuclear

996. The pioneer country in the production of fuel-alcohol is

(a) Saudi Arabia (b) Iran, Iraq (c) Brazil (d) Japan

997. Existence of coal and petroleum may be detected with the study of

(a) Palaeobotany (b) Ecology (c) Bacteriology (d) Economic botany

998. Major source of liquid hydrocarbon is

(a) *Calotropis gigantea* (b) *Cocos nucifera*

(c) *Euphorbia antisyphilitica* (d) *Solanum tuberosum*

999. Biofuels are

(a) Renewable (b) Orthodox (c) Pollution producing (d) Organic wastes

1000. While India's population is 15 percent of the world, its annual energy consumption is only

(a) 0.2% (b) 2% (c) 10% (d) 25%

1001. A species selected for energy transplantation must not be

(a) Slow growing (b) Pest resistant (c) Hardy (d) Local

1002. Energy plantations vary from energy cropping in being

(a) Substitute for petroleum (b) Source of fuel wood

(c) Renewable (d) None of these

1003. Which wood burns for short period of time

(a) Gymnosperms (b) Angiosperm (c) Dicotyledonous (d) Monocotyledonous

1004. A Bioenergy source obtained by fermentation to supplement fossil fuel petrol is

(a) Kerosene (b) Ethanol (c) Diesel (d) Methane

1005. Where do tropical wet evergreen forests occur in India

(a) J & K (b) Himachal Pradesh (c) Bihar (d) Andamans

1006. The energy obtained from 85 million animal power is equivalent to

(a) 350 *MW* (b) 3500 *MW* (c) 30500 *MW* (d) 35000 *MW*

1007. What type of fuel are coal, petrol and natural gas

(a) Biofuels (b) Electrical fuels (c) Fossil fuels (d) Liquid fuels

1008. Cultivation of more fuel wood trees is known as

(a) Afforestation (b) Energy plantations (c) Energy cropping (d) Deforestation

1009. The calorific value of biogas is

(a) 10 – 20 mj/m^3 (b) 23 – 20 mj/m^3 (c) 35 – 40 mj/m^3 (d) 5 – 10 mj/m^3

1010. A good fodder

(a) Contains high dry matter (b) Is free from disease and pest

(c) Has nutrient without toxicity (d) All of these

1011. The current consumption on domestic fire wood in India is about

(a) 18.6 million tonnes (b) 146.5 million tonnes

(c) 1246 million tonnes (d) 21870 million tonnes

1012. For biogas production besides dung which one of the following weed is recommended in our country?

(a) *Eichhornia crassipes* (b)*Hydrilla* (c) *Mangifera* (d) *Solanum nigrum*

1013. Daily input of sunlight per square per day on the earth is

(a) 100 *gm cal* (b) 400 *gm cal* (c) 4,000 *kcal* (d) 40,000 *kcal*

1014. Which one of the following is a petroleum plant?

(a) *Euphorbia* (b) Potato (c) Sugarcane (d) Maize

1015. The incorrectly matched pair is

(a) Biogas produced from dung (b) Latex source of liquid hydrocarbons

(c) Ethanol used as gasoline (d) Animal energy used most efficiently

1016. The value of solar energy **or** Extra terrestrial light reaching the biosphere is

(a) 2 *g cal/*cm^2/min (b) 30 *g cal/*cm^2*/min* (c) 1 *g cal/*cm^2*/min* (d) 10 *g cal/*cm^2*/min*

1017. Solar energy transducer is

(a) *Agaricus* (b) *Rhizobium* (c) *Orobanche* (d) *Chlorella*

1018. HMP is equivalent to …… total electricity generated/year in India

(a) 2/5 (b) 1/3 (c) 1/4 (d) 1/5

1019. Which of the following is the hardest wood?

(a) *Shorea robusta* (b) *Tectona grandis* (c) *Cedrus deodara* (d) *Dalbergia sisso*

1020. The black wood tree of India is

(a) *Acacia nilotica* (b) *Dalbergia sissoo* (c) *Dalbergia latifolia* (d) *Mangifera indica*

1021. A source of good firewood is

(a) *Pinus* (b) *Cedrus* (c) *Albizzia* (d) *Dracaena*

1022. It is possible to extract maximum energy from wood through

(a) Biomass (b) Cracking (c) Direct burning (d) Gasification

1023. Energy from wood must be extracted more efficiently through

(a) Carbonisation (b) Pyrolysis (c) Gasification (d) All of these

1024. Wood of Pinus is

(a) Pynoxylic (b) Polyxylic

(c) Monoxylic (d) Pynoxylic and monoxylic

1025. The fuel wood crisis can be overcome by

(a) Efficient forest extractions (b) Afforestation

(c) More efficient heat transfer (d) A combination of these

1026. The best source of alcohol is

(a) Wood (b) Noble cane (c) Tapioca (d) Barley

1027. The wood considered unfit as fuel is

(a) *Bombax ceiba* (b) *Madhuca indica* (c) *Pinus roxburghii* (d) All of these

1028. An ideal good fuelwood is obtained from

(a) *Bauhinia racemosa* (b) *Dalbergia sissoo* (c) *Michelia excelsa* (d) *Mangifera indica*

1029. 'Sun basket' is

(a) The device to utilize sunrays directly to meet the requirement of heat energy

(b) The sufficient amount of sunlight stored in a cell

(c) A device of taking sunbath

(d) All of these

1030. The term for a blend of 10-15% ethanol with petrol is called

(a) Gasohol (b) Glycol (c) Xylol (d) Hexanol

1031. The correct match is

A. HMP	1. Good fire wood
B. DAP	2. Running engines
C. Petroleum plants	3. One fifth of total electricity
D. *Acacia* and *Azadirachta*	4. Camel, horse and elephant
E. *Bauhinia* and *Pinus*	5. Bad fire wood

Correct paid is

	A	B	C	D	E
(a)	1	2	3	4	5
(b)	3	4	2	1	5
(c)	5	4	3	2	1
(d)	4	3	5	1	2

1032. Advantage of energy plantations is

(a) Running nuclear plants (b) To reduce pressure on forests

(c) To decrease soil erosion and pollution (d) Both (b) and (c)

1033. Gobar gas contains mainly

(a) $CH_4 + CO_2$ (b) $CH_3 + O_2$ (c) $CO_2 + H_2$ (d) $CO_2 + H_2O$

1034. In developing countries, the heaviest demand on forests is for

(a) Fuel wood (b) Furniture wood (c) Fruits (d) None of these

1035. Citric acid production is by action of

(a) *Aspergillus niger* (b) *Acetobacter* (c) *Candida* (d) None of these

1036. Non-renewable substance or resource is

(a) Planktons and fishes (b) Fossils and minerals

(c) Animals and plants (d) Animals and minerals

1037. Thermal power generation is

(a) Conventional, renewable, polluting (b) Conventional, renewable, non-polluting

(c) Conventional, non-renewable, polluting

(d) Non-conventional, non-renewable and non-polluting

1038. Gasohol is

(a) 90% alcohol + 10% petrol (b) 10% alcohol + 90% petrol

(c) 20% alcohol + 80% petrol (d) 100% ethanol

1039. Most common biofuel, being used nowadays is

(a) Cellulose (b) Charcoal (c) Natural gas (d) Fuel wood

1040. Petroplants were first recognized by

(a) Lamarck (b) Darwin (c) Hatch and Slack (d) M. Calvin

1041. Growing of plants for alcohol production is called

(a) Energy plantation (b) Energy cropping (c) Biomass production (d) None of these

1042. Pyrolysis of wood is responsible for yielding

(a) Alcohol (b) Charcoal

(c) Charcoal and gas (d) Charcoal, gas and oil

1043. Producer gas is produced by …… of wood

(a) Carbonization (b) Gasification (c) Pyrolysis (d) Hydrolysis

1044. Gasohol mixture is useful as

(a) Fermenter (b) Manure (c) Automobile fuel (d) All of these

1045. Which of the source of energy is non-renewable

(a) Wild life (b) Forest wealth (c) Coal reserves (d) Hydel-power

1046. The energy obtained from biological resources is called

(a) Electrical energy (b) Mechanical energy (c) Bioenergy (d) Life energy

1047. Fuel wood is

(a) Source of petroleum products (b) Renewable resource of energy

(c) Source of biogas (d) Source of alcohol

1048. Which of the following is more efficient in converting solar energy?

(a) *Chlorella* (b) *Cuscuta* (c) Earthworm (d) Tiger

1049. Petroleum resource is

(a) Renewable (b) Non-renewable

(c) Synthetic and biodegradable (d) Infinite and unconventional

1050. Which one of the following is a renewable source of energy?

(a) Petroleum (b) Coal (c) Nuclear fuel (d) Trees

1051. Producer gas consists of

(a) CH_4, CO_2, H_2 (b) CO_2, H_2, N_2 (c) CO, H_2, N_2 (d) CH_4, H_2, N_2

1052. Sap of which plant is considered as a good substitute for diesel oil?

(a) *Euphorbia sp* (b) *Copaifera longsdorfii* (c) *Calotropis procera* (d) *Manihot glaziovii*

NEW AND UNDERUTILIZED CROPS

Basic Level

1053. A new crop, which is the source of high performance lubricants is

(a) *Simmondsia chinensis* (b)*Parthenium argentatum*

(c) *Psophocarpus tetragonolobus* (d)*Leucaena leucocephala*

1054. Which of the following is underutilized oil crop?

(a) *Brassica campestris* (b) *Cocos nucifera* (c) *Azadirachta indica* (d) None of these

1055. *Triticale* is a man-made cereal which has been developed through hybridization between

(a) Wheat and Gram (b) Wheat and Rye (c) Wheat and Oat (d) Wheat and Rice

1056. An underutilized plant which grows in deserts of Mexico and commonly called 'hohoba' is

(a) *Psophocarpus tetragonolobus* (b) *Simmondsia chinensis*

(c) *Leucaena leucocephala* (d) *Parthenium argentatum*

1057. *Triticale* is used

(a) For bread making (b) For forage (c) As medicine (d) None of these

1058. Underutilized oil crop is

(a) *Azadirachta indica* (b) *Shorea robusta* (c) *Madhuca indica* (d) All of these

1059. Hexaploid wheat is

(a) *Triticum monococcum* (b)*T. durum* (c) *T. turgidum* (d) *T. aestivum*

1060. First man made cereal (i.e., *Triticale*) is

(a) Octaploid (b) Hexaploid (c) Both (a) and (b) (d) Diploid

1061. The non traditional potential source of oil crops is

(a) *Cucurbita foetidissima* (Wild gourd) (b) *Citrullus colocythis* (Colycynth)

(c) Both (a) and (b) (d) Margosa

1062. Winged bean (*Psophocarpus tetragonolobus*) is a

(a) Plant similar to soyabean in nutritional value (b) New potential crop

(c) A nitrogen fixing vine (d) All of these

1063. Which of these is not correctly matched

(a) *Parthenium argentatum* – Furniture wood is obtained

(b) *Leucaena leucocephala* – Fixes atmospheric nitrogen

(c) *Simmondsia chinensis* – Liquid wax is obtained

(d)*Psophocarpus tetragonolobus* – Seeds are nutritive

1064. A fast growing small leguminous tree whose leaves being rich in nitrogenous compounds are a good green manure is

(a) *Dalbergia* (b) *Leucaena* (c) Guayule (d) Jojoba

1065. The potential source of natural rubber is

(a) *Ficus benghalensis* (Banyan) (b) *Ficus elastica* (Rubber plant)

(c) *Parthenium argentatum* (Guayule) (d) All of these

1066. The liquid wax is obtained from

(a) Sperm whale oil (Spermaceti) (b) Jojoba (*Simmondsia Chinensis*)

(c) Both (a) and (b) (d) Blue whale oil

1067. Jojoba is

(a) *Crotalaria* (b) *Simmondsia chinensis* (c) *Parthenium* (d) *Leucaena*

1068. The common name of *Leucaena leucocephala* is

(a) *Leucaena* (b) Babul (c) Sissoo (d) Subabul

ANSWER

ASSIGNMENT (BASIC & ADVANCE LEVEL)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	a	b	a	a	a	a	a	b	a	b	a	a	a	c	a	c	a	c	b
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
a	b	d	b	d	a	b	a	b	c	a	a	a	c	b	d	d	d	a	b
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
a	c	b	b	d	a	a	a	b	b	d	a	b	a	a	c	b	a	b	b
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
c	a	c	c	b	a	d	d	d	c	c	a	a	c	b	a	a	b	b	a
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
c	a	a	a	a	b	a	a	a	c	d	b	d	b	a	a	b	c	c	d
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
c	c	d	c	b	a	c	c	c	c	c	b	a	a	c	c	c	a	d	b
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
b	b	a	a	a	b	b	c	c	b	b	b	c	b	d	c	a	b	a	a
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
b	c	c	c	d	b	b	c	a	a	d	b	a	a	b	a	b	d	b	c
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
c	d	d	d	d	a	a	b	d	c	b	c	a	a	d	c	a	d	a	c
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
c	a	b	d	d	c	b	b	a	b	d	a	b	b	c	c	c	d	a	d
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
c	c	b	b	b	b	c	a	c	b	d	c	a	a	c	d	a	c	a	b
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
c	c	a	a	a	a	d	c	a	d	c	d	a	d	d	c	d	c	a	d
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
d	c	a	b	d	b	b	d	a	d	b	a	b	d	c	b	d	c	b	b
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
d	c	c	c	d	a	a	d	d	a	d	d	c	a	c	a	b	b	c	c
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
c	c	a	a	b	d	c	b	b	d	a	b	d	d	a	d	c	c	b	a

301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
d	a	b	d	c	c	c	a	b	b	d	a	a	c	c	c	c	b	b	c
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
b	a	b	c	a	a	c	a	a	c	c	a	c	d	a	a	c	b	a	b
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
c	d	a	d	b	d	a	c	a	c	d	a	b	d	b	a	b	c	c	a
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
b	a	a	a	b	a	c	b	b	c	a	b	c	b	b	c	b	d	c	a
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
d	d	a	a	d	d	c	a	b	d	b	a	b	c	c	d	b	c	b	d
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
a	a	c	c	b	d	a	c	b	d	b	a	b	c	c	d	c	c	c	b
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
b	c	a	a	c	c	b	c	d	d	c	d	c	c	c	d	a	a	c	d
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
b	d	a	b	d	b	c	d	a	b	d	a	c	a	b	c	a	a	d	a
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
d	d	c	c	b	d	d	d	a	c	a	c	b	d	b	b	c	b	a	d
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
a	c	b	d	c	b	d	b	c	a	b	c	c	c	a	a	a	a	c	a
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
c	a	d	c	b	b	a	d	a	c	c	a	b	d	d	c	c	a	c	c
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
c	a	b	a	a	c	a	b	b	a	a	b	b	a	a	d	a	c	c	c
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
c	b	a	b	d	b	b	d	c	a	a	a	a	c	b	d	c	b	d	c
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
d	a	b	d	d	b	b	b	a	b	a	a	c	d	c	a	b	d	c	a
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
c	b	a	a	b	c	d	b	a	a	c	c	a	b	a	c	a	a	b	b
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
b	a	c	d	c	d	c	a	b	a	c	c	c	d	b	d	c	b	c	a
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
d	c	a	c	d	b	a	d	b	c	b	c	d	b	d	a	c	a	b	d

641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
c	d	d	b	a	c	b	b	a	b	a	a	b	d	b	c	a	b	b	d
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
c	d	d	d	b	a	c	a	a	d	d	d	d	b	c	c	a	b	c	d
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
d	c	a	b	c	d	d	d	c	a	a	b	d	b	c	b	a	a	b	b
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
d	b	c	c	d	d	c	a	b	c	a	b	d	c	a	a	b	a	c	b
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
b	c	b	c	a	c	a	d	d	c	b	a	c	c	a	b	b	d	d	d
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
d	b	a	a	a	c	b	b	b	a	d	b	d	b	b	c	b	b	a	c
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
a	a	a	d	a	b	a	d	a	d	d	c	a	a	c	d	b	c	a	b
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
b	c	c	c	d	c	d	d	d	d	c	b	a	c	d	b	a	c	b	d
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
c	b	a	d	c	b	b	d	d	b	a	a	b	d	b	a	c	a	b	d
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
b	b	b	c	a	a	a	c	a	b	d	a	a	d	a	c	d	d	a	c
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
d	a	d	d	c	a	c	a	c	b	c	d	d	a	b	c	d	b	a	a
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
b	d	d	b	b	b	b	c	a	c	b	d	c	d	b	a	c	c	b	d
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
b	a	b	b	b	c	d	c	a	b	c	d	c	d	c	d	a	b	c	a
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
b	d	c	a	d	b	a	c	b	a	a	b	a	a	a	b	c	b	d	a
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
d	b	d	c	d	b	c	c	a	c	b	d	d	a	d	d	d	b	a	c
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
b	d	a	a	b	d	b	c	d	c	d	d	a	a	b	d	a	d	d	b
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
b	b	d	c	c	a	c	b	d	b	b	b	b	b	a	b	d	b	a	d

981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
b	c	a	d	b	d	a	a	b	b	c	b	a	d	c	c	a	c	a	b
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
a	b	a	b	d	c	c	b	b	d	b	a	c	a	d	a	d	d	a	a
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
c	d	d	d	a	b	d	b	a	a	b	d	a	a	a	b	c	b	c	d
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
b	d	b	c	c	c	a	a	b	d	c	b	a	c	b	b	b	d	d	c
1061	1062	1063	1064	1065	1066	1067	1068												
c	d	a	b	c	c	b	d												

***